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WALKS UNDER THE SEA BY A CORAL STRAND.

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I VIVIDLY recall a scene which suddenly presented itself upon entering one of the broad bights which indent the eastern shore of Andros Island, Bahama. Once within the reef, which here leaves a wide channel between it and the shore, the prospect immediately changed like the shifting of scenery. We now sailed in a transparent, almost colorless medium, which stretched far away on every side. The sea just left behind seemed to rise up and enclose this water-island with a black, impenetrable wall, so great was the change in depth, and so intense was the light reflected from the mirror of coral sand on all the submerged reefs and banks. Ever and anon this dark ocean-line was broken into bars of silver—the glistening foam of breakers, which betray unseen and treacherous rocks. These radiant fields were pied with dark patches of sea-weed, and dappled with sombre masses of coral and sponge. By this celestial gate one imagines himself to be entering a city, the tops of cocoa-palms and other trees which alone are visible on yonder shores, answering to the spires and masts of some inland port.

The scale of colour ever changes with the altitude of the sun, with the character of the sea-bottom, and with the clouds, now flashing green fire on the horizon, and reflecting many intermediate tints between it and the crystal water at our feet. The

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storm-clouds rising fast, and blackening all the sky, are thus doubly felt by their effects on the sea, which transmits the deepest shades that are possible in the ultramarine. Their high colour effects are due not only to the clarity of the sea, but also to those white calcareous particles, the coral sands, which the ceaseless grinding of the breakers on the reef is ever producing and ever sifting far and near over the wide sea floor. The sands which fill every lagoon and bay, are tossed up in long dazzling lines of smooth beach, and in course of time may become hardened into coral limestone like that out of which these islands are formed. The depth of coral waters is singularly deceptive, owing to the light reflected from the bottom, and there results that wonderful distinctness with which a varied host of living forms like the coral, the starfish and the sponge, can be clearly seen even at great depths. The remorseless green of the sturdy tropical bush which covers all the shores, and which knows no change of seasons, is thus relieved by a wide sea-girdle of ever varying tints.

The Bahama Islands are all coralline; that is they are due (primarily) to the life and growth of coral polyps, insignificant animals when contemplated singly, but able to girdle the globe, only give them time and the right conditions.

New Providence, where I spent several months in the study of marine life, is the geographical as well as the commercial and political centre of the group. It is a small, compact island, 17 miles long east by west, and 7 in greatest breadth. Its southerly half is cut by the 25th parallel of latitude, and the longitude of its capital, Nassau, is 77° 22′ W., which is a little west of Washington. While it is just without the tropic line, it is nevertheless considerably within the northern borders of tropical life.

The Bahama Islands, though widely separated, are yet remarkably alike in their animal and plant life, and this simularity, which is doubtless shared by all coral rocks and isles in West Indian seas, is due to like physical conditions. All of them are essentially rocks formed by the hardening of coral sands, usually low and flat, but sometimes rising into undulating hills, or making precipitous bluffs and shelving cliffs.

A slight eminence commands a wide prospect on a coral island, and I was particularly impressed with this fact one June day upon climbing the slope of a ridge which skirts the north-easterly shore of New Providence. Leaving the clean coral street at Dix Point, where an old gate guards the entrance to a disused lane, and where the crumbling walls of a cottage on the hillside above bear witness to better days, a momentary scramble through the thick bush brings you to the top. Far along the shore winds the emerald bay, hemmed in by long narrow islands, which, as we glance down the reef, gradually fade into the blue of the sky and of the sea. On the other hand lies New Providence, a vast mosaic in greens, the darker settings of the pine and of the palm mingling with the light new growth of this ever-springing vegetation. This wilderness of color, this green mantle of perpetual spring, is thrown into long folds, some eight of which I can count at this height, all of them running nearly parallel with the ridge on which we stand. They resemble lines of sand dunes, now hardened into stone and clad with vegetation, as possibly they are, such as may be seen on some of the island reefs, over which the ocean occasionally breaks in violent storms.

Much as these coral islands may interest us from their animal and plant life, which has also a story to tell, yet those *gardens under the sea*, the living coral reefs, to which these green specks at the surface owe their origin, introduce us to an entirely new world, to a fairy-land of strange forms and bright hues, far more populous and varied than that which fired the enthusiasm of its first discoverer.

Dix Point, of which I speak now more particularly, since it is an admirable specimen of a living, growing reef, forms the southern arm of a small winding bay not far from the north-eastern extremity of New Providence. The point is a low spit of land, or more specifically *rock*, covered with a growth of tropical bush, in which we notice the mangrove, the stilt-walker of the tropical swamp, the fragrant flowered logwood, the hoary conocarpus, and the round-leaved sea grape (*Coccoloba*). Some stone ruins on the eastern side, gray with age and half concealed by the encroaching bush, mark the abode of former and long forgotten

residents. Here as elsewhere the tide touches the threshold of vegetation, and with the ebb the exposed shallows make a wide beach-way, and the eroded rocks of the point are laid bare. The latter represent *hard-pan*, the stone foundation of the islands, which are capped with at most a very thin and discontinuous layer of soil. The extension of this Point under the sea is the reef which we are going to explore.

Nassau Bay is here less than a mile wide, and presents in strong lights a clear green surface, streaked and flecked with dark beds of sea-weed, which contrast strongly with the lights reflected from its clean white bottom.

Having no diving-bell or boat of the Jules Vernian type at our command, we will enter the sea garden in true native fashion with water-glass and sponge-hook, with a light suit, and above all with a shoe which is proof against the venomous darts of the black sea urchin.

With the water-glass in hand you are equipped for the voyage. With this clear eye you can read the secrets of the sea bottom at any depth you please—2, 10, 20 fathoms. The crystal water is like a lens, and the sandy bottom like a white screen, which reflects and diffuses a soft light through the ocean depths. We behold a tropical forest in miniature as in a Claude Lorraine glass, in richness of color, in variety of form and in wealth of animal and plant life far surpassing anything that the shores produce. The quivering fans and gay plumes of gorgonia, the delicate sprays and wide branching arms of living corals, are the trees of this submarine garden, while sea anemones and algæ of many hues are the flowers and sward. Here and there are large mushroom-like masses of the brain coral. Sheltered beneath the coral boughs lie innumerable sea urchins, bristling all over with black, shiny needles. Splendid fishes dart in and out among the tremulous fans, while a myriad of smaller animals dwell unseen at the bottom of the reef.

Studying more closely the revelations of the water-glass, we see that the prevailing colors are shades of brown with bold touches of purple, red, yellow and green, not to speak of the resplendent hues of the many forms of animal life which make their home on

the reef, the mere naming of which would read like the inventory of a museum.

The sea fans (*Gorgonia flabellum*) are not to be mistaken. They stand erect, firmly anchored to the stony floor, and are forever repeating the slow undulating movements of the water. Their lace-like texture distinguishes them at once from the related "sea-feathers" (*Pterogorgia*), whose graceful nodding plumes, sometimes six feet tall, are the branching foliage trees of the coral garden.

Fish swim amid the waving fans, and thread the maze of the coral caves, as much at home as the birds in the neighboring bush, and far surpass the latter in the brilliancy of their colors. It is a memorable though common sight to meet a school of fish moving leisurely over the reef. Through the softened light and clear perspective of the water you see a hundred shining forms pass slowly across the painted screen, amid lilac fans and coral-sculptured rocks. Some are armored with a coat of burnished cerulean scales, or banded with black and blue, or, like the grotesque trunk-fish (*Ostracion*), dappled with a variety of tints. A blue fish (not the market fish, but a very different and very much bluer species, from whose iridescent, cobalt scales, the natives of New Providence make pretty ornaments) may be seen lazily swimming over a sand-bottom, which they frequently probe with their blunt noses, their bright coats gleaming with every lash of the tail and movement of the body.

The *turbot*, as he passes, ogles you with his large, glassy eye, or pokes his inquisitive nose into a sponge, — an odd fish from every point of view. He is about as broad as long, and has an ugly looking mouth with projecting teeth, and a deeply forked tail, the ends of which are drawn out into long streamers. The dorsal fin is peculiar, and has given rise to its nickname, the "trigger-fish." By a simple anatomical arrangement, the foremost spine of this fin, which is a sharp, dagger-like weapon, when once erect cannot be pressed down, but touch the smaller spine next to it, and down it falls like the trigger to a gun.

Perhaps one of the most striking fish we meet on a coral reef, although it is hard to decide which is the most striking, is the "hog fish," as it is called by fishermen on account of the grunt-

ing sound it makes when taken from the water. Its general shape is that of a sun fish or bream. It is jet black, excepting the head and tail, which look as if they had been dipped in a golden-yellow dye.

The brain corals (*Diploria cerebriformis*) already referred to, whose rounded surfaces are stamped with those peculiar, intricate patterns, take a high rank among reef-building polyps. They form masses from a few inches to several feet in diameter, or cover the bottom with large convoluted plates (*Meandrina.*) These help largely in building up the "coral-heads," the highest points on a growing reef, where the word is synonymous with *dangerous rocks.* A dozen different species may contribute to the growth of the head. Sponges and gorgonias attach themselves. You may see the bright rosette of a sea-anemone fastened to a stone, or detect the long "feelers" of the spiny lobster projecting from some niche in the wall. Boring sea-urchins, mollusks and barnacles perforate the living stones and thus assist the destructive action of the waves. This explains the detached fragments of coral which we see strewn everywhere over a reef. They fall an easy pray to the waves, and are slowly pounded into fine coral sand like that of the beach. This beach-sand is then endlessly rocked and shifted about, mixed with pieces of coral, conch shells, and with the bones or stony remains of countless marine organisms which inhabit the neighboring sea, until the whole is sometimes cemented into compact sand-stone, the ultimate building material of reef or island. By thus continually extracting matter from the sea water, and yielding it up in the form of solid particles of carbonate of lime, the insignificant polyp contributes to the growth of continents.

The delicate madrepores (*Madrepora arbuscula*) resemble deer's antlers or the forms of some branching shrubs, which the least blow shivers in pieces. In the water they have a light lavender hue, but bleach to snowy whiteness in the sun. The "propeller coral," as it is called by the natives, resembles clusters of brown leaves. In some places the bottom is fairly peppered with small coralline masses, the size of paper weights, their surface deeply indented with vermiform characters, well named "*chenille-stones*"

(*Manicæna areolata.*) In the "lancet coral" the partitions or thin plates lining the folds are beset with sharp cutting teeth.

The floor of a coral reef is a mosaic of living stones. The prevailing hues are browns, yellows and greens, which are relieved, as we have seen, by touches of bright colors. As the back ground of a forest enhances by the contrast the bright liveries of the birds and insects and the painted petals of flowers, so the sombre coral masses are illumined by purple alcyonaria, by scarlet actinia, by the vermilion heads of worms, and by the varied colors of the throng of animal and plant life.

On the land as in the sea the greatest harmony of colours seems to prevail among those forms which are capable of the least motion, like the stationary trees and the solid coral-stocks, while the restless fish, the crabs and worms which crawl at will over the bott n or thrust their heads from their burrows, the sea-anemones which, however incapable of active locomotion, can so retract their bright bodies that only an obscure disc is seen, may all wear the richest and most varied hues.

The meaning of colors in the organic world, if they have a meaning, is a subject of great interest, and it is commonly believed that the color of many animals has been acquired by natural selection, and has a protective significance, which is probably true. It has been discovered that certain insects are protected by the extraordinary and forbidding brilliancy of their colors, and by assuming the colors of common poisonous species, thus sharing the latter's immunity from harm. But many phenomena which we constantly meet with are not to be thus explained. A case in point of much interest is that of the West Indian shore crab (*Gregarinus ruricola*). This beautiful crab burrows in the mangrove swamps at about the level of high water, and is common throughout the Bahamas. I happened to land at the eastern extremity of Hog Key one day in April, just after heavy rains had flooded the island and routed the shore crabs from their dwellings. Nearly every green spray and bough was ornamented with these handsome crabs, which were decorated in the brightest and most varied hues. Some of them have the legs crimson and the body a dark purple, with a large yellow

spot like an eye on each side of the back. In others these tints are reversed, the spots being purple on a light ground. Others again are nearly black, or the carapace is orange or straw color flecked or marbled with purple, or the body is purple tinged with orange, in an endless series of patterns so that no two are alike. These fickle colors seem to be all for show. They plainly have no protective meaning, but are due to some subtile physiological cause of which we are ignorant.

A negro was living near this spot above a little stretch of white beach, and under the shade of a beautiful grove of cocoanut palms. About his cabin were strewn the telling remains of many crab dinners. He told me that these animals "begin to crawl" after rain at about 8 o'clock in the morning, and disappear again about 4 in the afternoon. Their legs are fringed with sharp spines or climbers, by the aid of which they readily ascend trees, and the large pincers which they brandish, not without effect, show plainly that they are able to protect themselves.

The crabs have many queer habits. An odd freak is that of tucking little stones in their ears after moulting the skin, but what is more surprising is the apparent indifference and address with which they will sometimes amputate their own limbs. I saw a good piece of this invertebrate surgery one day when I captured a shore crab which was crossing the road. A crab always cuts a comical figure as it runs sidewise, eying you with its optic organs raised aloft like a pair of opera glasses. As Charles Kingsley says of the four-eyed fish, he who sees a crab scuttling across the road for the first time without laughing must be much wiser or much stupider than any man has a right to be. I had pinioned this crab with my foot, and held him as I supposed securely by the "great pincers," one in each hand, when he suddenly dropped both claws, and scuttled off with apparent unconcern, although he had parted with his most valuable weapons. [1]

[1] This is a genuine amputation, and is not due merely to accident or to the fragility of the legs. Experiment has proved that it is caused by a vigorous muscular contraction, and that it is a reflex act. The limb of a dead crab, or of one in which the nervous system has been paralyzed, will lift a weight of several pounds. Any profound nervous shock like that given by rapidly cuttting off part of a leg with sharp scissors, or by electrical or chemical stimuli, produces the same result.

The comparison of a coral reef to a garden of plants or of the branching coral to a tree has a significance which it is interesting to notice. The tree and coral agree in being plant and animal communities, leading a composite or corporate life of mutual benefit. That the tree is a community is seen by its reproducing by buds, by cuttings and roots, as in the case of the Banyan or Pagoda Fig Tree of India, where a whole forest may arise from a single seed. The life of the tree is moreover near the surface, in the sap wood, while the heart is practically dead and useless, except for support.

So the coral starts as a simple egg or cell, and by the asexual process of budding builds up a community. The coral stock is alive only at the surface, the superficial polyps resting on the dead skeletons of previous years, as the living wood rests upon the rings of old growth. This comparison fails completely with the feeding of these communities, since the tree takes its food not only by the leaves but by its new roots, while a coral has no living roots, but gets all its nourishment from the water through the mouths of the individual polyps,

An abraded skin and lacerated fingers await the diver on a coral reef, for its wonders cannot be explored without cost. The indescribable glimmer which pervades the transparent waters, subdues and blends all distant objects, and plays in a green light at the surface. This is the veil which the sea nymphs hold before the eyes of the visitor to their realms.

A light cream-colored species related to the fan-corals are the "nettles" of the reef, which one is sure to meet on his first visit thither, and equally sure to avoid on his next. They encrust stones or corals of other species, and, being amply provided with poison cells, are like fire to the touch. Most of the common corals and sponges are found at ebbtide in from one half to two fathoms of water or even at less depths. They die quickly when exposed to the sun, and if transferred to the sea again they become skeletons in a few hours.

The black sea urchin (*Diadema*) to which allusion has been made, is the bug-bear of the reefs, and every experienced person gives it a wide birth. The white sand is sometimes blackened

by them. The body of the animal, though small, is stuck so full of long black needles that it makes a bristling ball more than a foot in diameter. Each spine is a poisoned dart, and as brittle as glass. At some points on a reef you can hardly turn a stone without encountering this black monster. The Bahaman diver and sponge fisherman know them well. I have heard them tell of several unfortunate men who received a full dose of this animal's poison. As to the pain and cramp which comes from a pin prick in the finger administered by this urchin, I can answer by frequent experience, and can readily imagine the exquisite torture, bordering on madness, which is said to result from closer acquaintance.

If we leave the reef and wander along the shallows of the bay, we see plainly written on its sands evidence of a different though by no means scanty population. Here, for instance, I see the sand-floor dotted with conical elevations like volcanoes on a raised map, with open craters at their tops, or it is there perforated with small holes. Resting on many of the latter I see spherical masses of a transparent jelly, looking as if it had been thrown out by an eruption from below, while long strings of this tremulous substance are protruding from others. These are the submarine dwellings of *annelids*—sea worms, which burrow deeply in the sand, and lay their tiny eggs, much after the manner of frogs, in large masses of jelly, which serve both for food and protection to the young. The number of the marine worms is well nigh countless. They roll out of nearly every sponge or rock which is brought up from the reef. Many are painted in the most delicate and exquisite colors, and suggest nothing that is repulsive. Some species build elastic tubes, a cluster of which is like a bunch of flowers. Each tube, the size of a pencil perhaps (when its tenant is undisturbed), is crowned with a circular fringe of brown or scarlet feathers. Stoop to pick the flower, and presto !—in a wink the worm has drawn in its feathery gills and shut the door, which does not open again for some time to come.

This sand is also dotted with groves and forests of palm-like algæ, whose slender stems, tufted with green, bear every resemblance to toy trees.

There are at least three star-fishes found in this bay, the largest of which (*Pentaceros reticulatus*), the star of the *new* "Curiosity Shop," is of the first magnitude, a foot or more in diameter. It is anywhere a conspicuous object, and its deep brown and yellow patterns show distinctly on the white sea floor. A five-pointed star is the rule, but occasionally a monster appears among them, who abbreviates the number of its arms to 4 or increases them to 6. I once found a small star with only three rays, and one day met with a large fellow, one of whose five normal arms had been amputated, bitten off by an enemy perhaps, and a new one was growing in its stead.

The beds of weed which extend as wide bands up and down the bay are occupied almost exclusively by a large white sea-urchin (perhaps *Hippomæ*), called the "Sea Eggs" from their white papery shells, which are often picked up on the beach. So thick are they it takes some care to avoid stepping on them, to do which with bare feet, to say the least, is certainly not pleasant, although the spines of this species are quite short and without venom. I am reminded of a pasture where the grass is cropped close. Here are forty thousand feeding like one, but not on the grass, for the cropping in this case is not from the herd. The sea weed or alga in question has a narrow blade a few inches long, which ends abruptly as if cut off by scissors. These sea eggs are all of about the same size—that of a flattened base ball, and the question at once arises, Where are the young and intermediate stages? I remember to have seen but one or two undersized sea urchins, although I made daily visits to the reef for many weeks. This is probably but a common illustration of the fact that the struggle for life is far greater with the young than with the adults. Of the newly-born host, a very large number must be overtaken by death before reaching the adult state. But the survivors live through many generations, and thus their numbers increase. If this were not so in the case even of a single prolific animal, the ocean would soon be overrun by it.

The flowers of the coral gardens are the sea-anemones or actinias. They look like bright rosettes, scattered here and there

for ornaments, now pinned to a coral tree or wall-side or half concealed in the grass.

The actinian is in fact a greatly enlarged coral polyp, but without a skeleton, and in consequence of this they can retreat so completely within themselves as to become almost invisible. Place one of these contracted discs in an aquarium of sea water, and a beautiful "flower" will soon unfold, to your astonishment, filling the whole jar. When this animal multiplies by budding or by division a new individual is formed like the first, and the two separate, so that the colonial stage is never realized. A common and large species (*Cereactis*) has a vermilion body, and drab, carmine-tipped tentacles. I once saw a patch of white sand bordered like a parterre by a row of these bright flowers on either side.

To one who has not given the subject a thought, it may take some stretch of imagination to associate the corals with the popular idea of animal life, but as we see the living mass, and the individual polyps, opening their mouths and extending their fringes of waving tentacles, any doubt in the matter will probably be removed. The coral stock or the sea fan is in fact a colony of animals, as truly as a hive of bees or an ants' nest is, but the former is composed of individuals united by a peculiar method of growth, while in the latter case the indiviruals are separate and specialized for different labors.

The coral polyp, which, in spite of the protests of naturalists, is commonly called an *insect*, by the popular error of including under this term most small and insignificant beings, is in fact further from the insect than the insect is from man. It starts life as a free swimming oval body, which hatches from an egg smaller than a pin's head. This active embryo acquires a mouth at one end, and is now significantly called a *gastrula* or stomach animal. It soon attaches itself by the opposite end to some rocky support, and thenceforward is a prisoner. This young polyp now develops tentacles or feelers about its mouth, and begins the deposit of lime which is to make its skeleton. This takes the form of a cup in which the animal rests, it being always external to its own skeleton. Thin partitions or septa grow inward from the

sides of this cup. They correspond to the tentacles, and with the latter increase in number with the age of the polyp according to definite laws. The animal then begins to reproduce asexually by division and budding, and the method and degree of completeness with which this is carried out, determine the form of the coral stock. The fragile madrepores branch in the most intricate manner, while other forms are massive, the cups of individual polyps being closely crowded and united in a common base. In the brain corals the sides of the neighboring cups unite to form intricately winding valleys.

The fan corals or alcyonaria (named for Alcyone, the daughter of Neptune) have invariably eight tentacles, and usually a horny instead of a calcareous skeleton. Under this head falls the *Corallium rubrum* of the Mediterranean, which yields the red coral stone of jewelry, but it is exceptional as regards its hard skeleton.

It quite as true of the corals as of the flowers of the field, "they toil not neither do they spin," and any metaphor of the poet which implies 'labor' or 'skill' in the polyp community such as we see in the construction of the honey-comb by the bees is rightly objected to as being misleading, since it is false to nature. The white and porous limestone structure which we call "coral," or technically a *corallum*, is in fact the inorganic frameworks of the polyp colony, and it costs the coral animals just as much labor as it does us to make the bones in our bodies.

Reef-building corals occupy a zone about 28° on either side of the equator and in both palæozoic and recent times they have produced important changes on the earth's surface, building up islands in the sea and adding to the coasts of continents. They do not flourish below a depth of 15—20 fathoms, and are absent from the mouths of rivers, since they require the pure sea water.

Once let the waves throw up a sand bar on the reef, and a new island is therewith born. A thousand and one objects attach themselves, and the constructive processes get the upper hand. The mangrove tree is an early visitor, and its peculiar methods of growth fit it admirably as a pioneer in the vegetation of the new island. The seeds of this plant develop in the calyx, before they fall from the tree, each sending out a curved cylindrical stalk

(radicle or caulicle) several inches long. These float like corks on the water, and the little plant, which now resembles a cigar loaded at one end, is ready to strike root wherever it touches soil. The young tree grows apace, and further shows that it has come to stay by sending down roots from the branches, which serve as little guy ropes to anchor it firmly in the sand, This new land is in a state of constant ebb and flow, until its sand bars and dunes have been firmly cemented into coral limestone. The sea and the rain eat away the soft rock, carving it into fantastic forms. A soil however will gradually accumulate in little pockets at the surface, where the seeds of plants brought thither by birds, by wind or wave, immediately germinate, and cover the already old yet new island with a mantle of green.

The whole subject of the formation of coral islands is now being vigorously discussed.

Before Darwin's day it was generally believed that coral islands were incrustations on the top of lofty sub-marine mountains. But when, 50 years ago, Darwin made his celebrated "Beagle" voyage (1832-1836), and afterwards published his account (second only in fame to his later theory of the origin of species), of the origin of these wonder-islands in mid-ocean, the older view was at once discarded. The key to his explanation was subsidence, the sinking of the ocean bottom. What were once table lands and mountains rising out of the Pacific and Indian Oceans, are now only sunken peaks crowned with coral limestone. The coral animals themselves impose, as we have seen, peculiar conditions. They require pure and warm sea-water and a bountiful supply of oxygen, and die if subjected to cold currents, to sediments, and if carried to a greater depth than 100 to 120 feet. With these conditions the problem seems simple enough. The land, a volcano we will say, is very slowly sinking in a tropical sea. The coral polyps will attach themselves to its shores, will grow within the zone of their bathymetrical life limits, and will gradually build up a fringing reef. As the mountain sinks this reef grows out from the land, since the outer corals exposed to the wash of the waves from the open sea, are in a better environment than those next the shore, and hence grow the fastest.

Then if the mountain sinks out of sight, the same processes continuing *pari passu*, the atol is produced, the last link in the chain of development. We begin with the fringing reef; we end with the atol, a ring of coral, with a central lagoon just over the mountain top. This is a brief and partial statement of the theory, which Dana substantially corroborates.

But in recent years much new light has been shed upon this fascinating subject, and it now appears as if Darwin's theory of coral reefs and islands, simple and plausible as it is, is destined to be set aside. It can be certainly said that it is not of general application. Agassiz found evidence of elevation in the Florida reefs, and later Murray, of the Challenger Expedition, has given an entirely new explanation of the Pacific coral reef and atol. This expedition, sent out to explore the deep seas, was equipped with all the appliances which modern science could command, and the importance of its results to the scientific world can hardly be overestimated. According to this observer, the principal factors in the formation of coral structures are the elevation in the deep sea of suitable platforms in which corals may build, either by volcanic action or by the deposit of organic sediments; the abrasion and solution of the coral rock itself. Of the subsidence which Darwin's view requires, there is no certain proof, while on the contrary in the Pacific and Indian oceans there has been in many cases an elevation of land. No trace of a sunken mountain peak as the base of a coral island has ever been discovered. The outer wall next the sea is usually not precipitous except for the first few fathoms. It then slopes off gradually to great depths. Oceanic islands are usually volcanic, and in moderately shallow waters there is a constant rain of minute solid particles to the bottom. These consist of siliceous and calcareous shells of the minute organisms with which the surface waters of the tropical seas are teeming. Having then a suitable base on which the corals may build, then the greater growth of the margin of the reef, and the erosion of the dead inner parts, will account for all the phenomena. As already said the coral island is formed by the accumulation of its own débris.

The ocean and especially the tropical ocean is, as it has always been, the great home of life. The forces which in cooler climates tend to repress and retard animal and plant life, here favor and force it onward. The battle for existence is here most incessant, its phenomena most marked. There results that boundless range of form and color, that exhaustless spring of individual life, which may well excite our wonder and our love.

THE ETIOLOGICAL CLASSIFICATION OF DISEASES.

BY FRANK S. BILLINGS.

BEFORE discussing this part of nosology it may be well to say a few words on the classification of diseases in general. First, we differentiate them according to that tissue of an organ in which the initial stage of the disease occurs, or in which the lesions predominate, or in other words, as to whether the active, or the stromatous, or supporting tissues are first complicated; that is, into interstitial or parenchymatous. It is well that this point be completely understood.

Those who are engaged in giving instruction in our medical schools, as well as those members of the profession who have an especial fondness for pathology, generally find that not only the students per se, but a great many practicing physicians, either have, or obtain, the idea that the above classification is something absolute, and that the processes are entirely limited to the tissues indicated in the differentiation. This is an error, but it seems to be a necessary failing of the text books to keep up this sharp differentiation, which would not be so serious had the authors but called attention to the fact that, while the pathological processes may begin in one kind of tissue, for instance the parenchymatous, if severe and prolonged in action they must eventually com-

plicate the interstitial also. This condition of things is far more common in regard to the extension of interstitial disturbances to the parenchyma, than the contrary, especially if parenchymatous disturbances are of short duration. Again, it is far more common in some organs than others, For instance, a parenchymatous pneumonia may exist to an excessive degree without any proliferation to speak of occurring in the stroma of the lungs; or a chronic bronchitis, which is partially parenchymatous and partly interstitial as to the bronchial tubes, may be present without any very serious disturbance of the alveola-epithelium, but a well-diffused and active interstitial pneumonia cannot occur without the most severe parenchymatous complications resulting in the complicated parts, due principally to the encroachment of the interstitial processes upon the walls of the blood-vessels circulating through the interlobular spaces, thus leading to severe circulation disturbances, and, eventually, stasis in many parts of the lungs. The condition seen in contagious pleuro-pneumonia in cattle is a striking example of this kind of extension. On the contrary, it is very seldom that we have severe and prolonged disturbance of the active substance in the dense glandular organs, such as the liver or kidneys, without more less extension of the processes from the parenchymatous to the interstitial tissue, especially in the vulnerable spots around the larger blood-vessels, or where bifurcation of vessels is present. Hence it is better to look upon this classification as having reference to the tissues in which the disease began, or where the disturbances have been initially the most severe, rather than that they have been, or are, limited to a certain tissue, as the names selected appear to indicate.

Again, we classify diseases according to the product, the nomenclature being self-explanatory, such as, caseous, fibrinous, or catarrhal pneumonias; a fibrinous or a serous effusion; a hæmorrhagic, or purulent, process, and so on. Such other means of differentiation as acute or chronic, or the various critical sub-divisions, need not be here mentioned.

With these few and imperfect remarks as an introduction, let us turn our attention to the etiological classification.

On this point we have the altogether antiquated classification of diseases into "Contagious, infectious and sporadic," which should be replaced to-day by speaking of them as:

Extra-organismal, or exogenous;

Intra-organismal or endogenous; and,

Sporadic; that is of undemonstrable origin;

or, in other words, from the etiological point of view we can logically classify diseasesonly according to the primary origin of their specific cause.

A recent reviewer in the New York *Medical Record* says of my "Investigations of Cattle Diseases in Nebraska," which includes some researches made upon alcoholic material from yellow-fever patients, that said work "contains much that is interesting, but is, unfortunately, very controversial in tone."

What nonsense! How can one ever hope to establish truth in the face of error but by controversy? To my mind, the more grievous the error, the more grievous the necessity for correct controversy, and there are some very grave reasons in this country why the controversy should be turned into a very severe battle for the truth, so far as original research is concerned.

Going back to our original differentiation for a moment, Hueppe has come to the same idea when he speaks of the micro-organismal causes of disease as "obligatory parasites," by which he means that such etiological moments are primarily bound on the conditions offered by some form of animal life for their existence and continuous development; or, in other words, such diseases are "endogenous" in origin, to speak with Pettenkofer, or intra-organismal in origin, as I have termed it. An endogenous disease is one which, so far as we can historically trace its genesis, has found and still finds its locus of primary origin for each new outbreak or extension of the disease, in a diseased individual of some given species of animal life (and never in any other way); and then passes directly from the diseased individual to another susceptible healthy one, either by direct contact, or cohabitation, or by contact with some effluvia which has either come directly from, or been in immediate contact or relation with, such a diseased individual.

Speaking in the old sense, such a disease would be "contagious."

Speaking acccording to the nonsensical usage of that word at present, no one can tell what its true origin might have been.

In contradiction to his obligatory parasitic diseases, Hueppe has given us the term of "faculative parasites," by which he means to indicate diseases of parasitic origin, but in which the focus of primary development (of the germs) is invariably outside the animal organism; still, that they have the faculty of living, for a time, within the organism of certain species of animal life, becoming parasitic or disease-producing for the time, when such animal organisms offer the necessary nutrient conditions to their life. To this class Pettenkofer has given the name of "exogenous," while I have termed them "extra-organismal," or diseases which found their primary origin in internal or surrounding conditions; or, in other words:

An exogenous disease is one which invariably finds its locus of primary origin not in, but outside of, an animal organism, that is, in the earth, or in the surroundings of animal life, where its micro-organismal cause develops under certain conditions of climate and soil which offer the necessary nutrients to its life and continuous development.

The infected earth or locality bears the same relation to animal life in the origin of exogenous disease that the infected animal organism does to healthy susceptible animals in endogenous diseases. That is, they each form centres of primary origin in their relation to specific diseases in their respective class, but with this difference: the focus of primary generation, or infection, is fixed in exogenous diseases, while it is movable in endogenous.

The *locus infectionis*, that is the point of primary infection or origin, is contagious in either case. In the one a healthy susceptible individual must come in direct contact, be upon or in such an infected locality, or come in contact with material derived directly from such a locality; while in an endogenous disease the same occurrences must take place in reference to some form of animal life. Hence it is to be readily seen that the word contagious has no logical use or place in the nosology of diseases, according to the results of modern investigation. Yet we find

members of "Boards of Health" and other hygienic organizations, and physicians, rolling off the word "contagious" with the utmost nonchalance in connection with Actinomycosis, a disease due to a fungus which invariably finds its primary origin outside any form of animal life, and primarily infests some form of vegetation in our fields and pastures. We find such authorities speaking of this disease as "contagious," because, by intentional inoculation of the Actinomyces from diseased to healthy animals, it has been found that, under favorable nutrient conditions, it will continue its development in the same. This absurd idea, that contagiousness and transmissibility are one and the same thing, has found its chief support in the teachings of Robert Koch and his school. So long as Koch keeps himself confined to the exact observational and descriptive ground of bacteriology his reputation is unquestionable, but the moment he touches the field of general pathology he shows the utmost incapacity for his work, and, as intimated above, has done more to mislead the medical profession of to-day regarding a logical understanding of the true nature of diseases genetically, than all other writers combined. Even the great authority of the world's greatest epidemologist, Pettenkofer, and the generally sharp and logical teachings of Hueppe, seem to have been utterly unable to stem the tide of misconception set flowing in full flood through the teachings and example of Robert Koch and his school.

They have spoken of the "contagium" of anthrax, black-leg, cholera, schweineseuche, and such diseases, all of which are faculatively parasitic; all of which find their locus of primary origin invariably outside of any and every animal organism.

Why?

Because such diseases are transmissible to healthy from diseased animals by artificial (or accidental) inoculation. The same is true of endogenous diseases if we have susceptible animals.

Anthrax can be transmitted to a man from the dirt where a diseased sheep, or ox, may have been buried. Syphilis can be transmitted from a diseased to a healthy man by an accident with a scalpel. What is the difference, then? According to Koch and his followers they are both alike. They are, in one sense, both

infectious diseases, but they are vastly different in point of origin, the one originating in and from infected earth, the other in and from a diseased individual. The source of primary origin alone decides this question. Accidental or experimental extension has nothing whatever to do with it.

But take another case which at the outset looks somewhat complicated. An ox is confined in a stable; it becomes diseased with anthrax; a fly stings it and then lights on the attendant and bites him; the man dies of malignant pustule. In this case the diseased ox was "contagious" to the fly and the latter to the man, but is anthrax a contagious disease? By no means; the fly was the accidental transmitter, the living syringe which filled itself from the blood of the ox and then introduced the infection to the man by its needle-like proboscis. The ox, however, became primarily infected from some source having no connection with animal life.

These statements of the case as to "contagion" and "contagiousness" should settle the question in every logical mind.

Remember, transmissibility of an inficiens either artificially or accidentally has nothing to do with the differention of infectious diseases as to class. The locus of primary origin and continuous natural development can alone decide as to whether a given disease is exogenous or endogenous in character.

Let us return to the question of the pathogenic nature of actinomycosis again for a moment. Actinomycosis is not an infectious disease in any true sense of the word, every authority to the contrary notwithstanding. An infectious disease, be it exogenous or endogenous in character, is one which is invariably accompanied at some time in its course by one general symptom, —fever, which is an invariable symptom of general or constitutional disturbance. The very word infection means that something has been produced which is of a general polluting character to the infected organism. Nothing of this kind occurs in actinomycosis per se. There is not necessarily any fever in this disease. Actinomycosis is always local, never general. Unless the disturbances are of such a character, or so situated, as to mechanically interfere with the functions of the organism, the individual does not

necessarily emaciate. Aside from pulmonary actinomycosis the invasion is dependent on the presence of some lesion in the mouth or pharynx, be it a diseased tooth or distended ostia to glands or ducts. Not even a diseased tooth is alone sufficient. There must be follicular disease also, or the actinomyces do not gain entrance. Wherever the symptoms of general infection are present in man or animal,—far more common in man,—it will be invariably found that the invading actinomyces are accompanied by one or more of the pus-producing cocci, *Streptococcus pyogenus albus* or *aureus*, or some really infection-producing organism. In such a case, then, we have a "mixed invasio-infectious pathological complex." I do not believe that a single case of actinomycosis in man was ever necessarily due to the presence of a diseased animal. Men have been exposed to a common cause, that is all, and have unfortunately presented some lesion which acted as an atrium to the actinomyces. A recently reported case where a veterinarian is said to have been dressing a "big jawed steer," and then scratched his own tongue with his thumb nail and acquired actinomycosis linguæ (if true), was but a fitting punishment for so filthy an individual, and proves nothing but the possibility of accidental transmission, which was known well enough previously without such a disgusting and crucial test.

If actinomycosis is so "contagious," what about the thousands of horses pastured annually and stabled with "lumpy jawed" cattle? If so terribly dangerous to man, why do we find so few cases when hundreds of men, not one with sound mouths, have been in contact with diseased cattle for years?

Another class of diseases of exogenous origin, but which differs from that previously considered, is known as malarial infectious diseases. They differ from all other exogenous diseases in that, while, like the others, local in origin, they always remain local; their cause cannot be transported in the body of a diseased individual, and secondary centres of infection be caused thereby, nor have they ever been transmitted by inoculation. Febris intermittens is a striking example of this class.

As of other exogenous diseases the micro-organismal cause of malarial infectious diseases also belongs to Hueppe's class of "fac-

ulative parasites," yet one is surprised and almost shocked to see that an observer generally so logical as Hueppe, and one for whom I have the greatest admiration and respect, should, in a late article upon the "Etiologie der Cholera Asiatica" (*Berliner Klinische Wochenschrift*, No. 9, 1890) speak of this disease, of which he describes the cause to be a "faculative parasite," in the following absurd, illogical, and most decidedly contradictory manner, when he says, "*Die Cholera asiatica ist wirklich eine miasmatisch-contagious Krankheit*,"—Cholera Asiatica is truly a miasmatic-contagious disease. A "miasmatic-contagion" is an unsupposable thing. A disease of faculative-parasitic origin cannot be contagious in any logical sense. The parasite finds its primary focus of development invariably outside of any animal organism, or it could not be faculative; and hence cannot be contagious. When will this absurdity be driven out of the minds of otherwise close observers and logical thinkers? A person affected with intermittent fever is neither dangerous to others, nor can such an individual infect new localities,—at least neither of these phenomena has ever been observed in the history of such diseases.

Invasion or Mixed Infection.

The time has certainly come in connection with micro-organismal-etiological research where most exact attention must be given to the pathological differentiation of germs which are not in any direct way connected specifically with the etiology of a given disease, and yet may be the cause of secondary or complicating lesions. Although I have not as yet published anything in detail upon this subject, still it has called for a large amount of very exact study and much experimentation. The one question which has been entirely overlooked is, that if an investigator desires to decide upon the specific infectious quality of a given germ when he finds it as a complicating phenomenon in a given disease caused by a well-known micro-organism, he must make his tests in that species of animals in which he found it, and not in any others. It must be understood that by infection we can only

mean one thing, and that is the pollution of the blood by some specific septic or toxic producer, let it be that that specific producer finds general distribution over the organism and develops or carries on its work in the blood, let it be that the producing organism is locally confined to its point of introduction (as in rabies, tetanus, etc.), where it produces the toxic (or septic) material, and from whence it is taken up by the circulation (lymphatic or blood) and distributed over the system, or let it be produced in some organ from whence the same effect is produced in the same way as in Asiatic cholera. Infection means the pollution of the system by something produced either generally, or locally, within it, and presupposes the continued production of such material for a given period by the producer, and its accumulation in the system both as a septic material and chemical irritant.

I cannot accept a late attempt at differentiating diseases in which the production of such an irritant takes place from the point of entrance to the organism as intoxicating diseases (tetanus, rabies), in contradistinction to septicæmic diseases, where the germs do not remain local. It might be well to call these forms of infection toxæmic, in order to distinguish them from the strictly septicæmic, where the polluting micro-organisms develop in the blood itself and thus pollute it. We have also others in which both phenomena take place, of which anthrax is an example. For me, intoxication diseases are those in which the organism is saturated by a given poison, which may be introduced in any way, but which is not generated either by any part of itself, or any parasitic organism which has been introduced. Poisoning, in the common acceptation of the term, is intoxication, let it be by morphine, nicotine, alcohol, or what not. Intoxication does not presuppose a poison-producer lodged in the organism. Infection does. Naturally, such a definition has no reference to uræmic or physiological intoxication, the nature of which should be self-evident. This form can well be called intra-organismal or cumulative intoxication, while the first-named could be termed extra-organismal, keeping in view our previously-considered classification of infectious diseases. Or, to speak with Hueppe, the one is obligatory intoxication (when the kidneys do not act),

the other faculative, or acquired by the individual. Or, in other words, the one form cannot be presented by the individual, hence is obligatory, while in the other he acquires the "faculty" of intoxicating himself.

To return to invasive complications: Correctly speaking, every lesion of parasitic origin must be considered as invasive in which specific pollution of the blood is not directly produced by the invader.

It has been said, and must be repeated, that the experimental test of this point must be made on healthy individuals of the same species in which the parasite was discovered, and if a micro-organism, by sub-cutaneous injection only.

I insist on the latter point with as much intensity as on the others that have been raised.

For instance, there are many micro-organisms found in the respiratory tract of animal life, or in the intestines, some of which under circumstances cause local lesions, and yet not one of them need necessarily be specifically infectious in or to the species of animal in which it was discovered. On the other hand, they may be violently so—septicæmic in rabbits, mice, guinea-pigs, or some of the many animals used in experimentation, the celebrated sputum coccus for example, and the majority of such organisms lately described by Miller in his work on "Bacteria in the Mouth." There are quite a number of such in the intestinal canal of hogs, but of those which I have thus far tested on rabbits, guinea-pigs, mice and ground-squirrels, and found fatal to one or the other, not one affected pigs in the least in very large amounts when introduced in the same way; that is, sub-cutaneously.

This class of germs is not specific in any sense of the word, according to our present knowledge. Not one of them is known to be the cause of a natural infectious disease in any of the animals in which they have been shown to have septic action by experimental inoculation. They should not even be called "pathogenic," as has been the case, as the word is misleading, and has too much of a specific sense to be used in this connection.

To any mind the only logical term to apply is, experimentally-infecting (not disease, but) micro-organism.

It may be asked why I have not reported upon my experiences with this class of germs? To which I reply, that once I had no interest in them, and not until circumstances made it necessary to bother with them did I give them any attention. Just at present they are having a "cumulative action," to be exploded with an intoxicating effect in certain directions when a suitable time comes.

It is my opinion that the U. S. Government "Swine Plague" is one of those cases of "mixed invasion," and I base that assertion on the fact that those who have tried have utterly failed (according to their published evidence) in sickening or killing a single hog by subcutaneous injection. I utterly ignore results following the injection of 8 or 9 ccm. of a bouillon culture directly into the lungs of a healthy animal. Just how many varieties of germs (absolutely non-specific) would cause pneumonia, and even gain entrance to the circulation and find more or less general distribution over the organism thus maltreated, can be determined by embryo experimenters; but it can be answered beforehand, Just as many as find suitable conditions for continued development in the conditions thus offered.

Welch himself says that not a single epizootic of his Swine Plague has been seen in this country. Then why has he insulted common sense and pathological knowledge by speaking of such an insignificant and completely undemonstrated complication as a new "Swine-Plague?"

It would be equally justifiable to speak of a large bacillus I shall speak of at another time as the cause of certain embolic hæmorrhagic lesions in the kidneys, seen sometimes in Swine-Plague, or as a specific or mixed infectious nephritis, because it often causes a mechanical-foreign-body-pneumonia for the same reason. It is not a specific germ. It does not cause infection. It is an invasion. The germ itself is absolutely harmless from the infection standpoint. It would be as sensible to speak of the filaria broncho-pneumonias in cattle, sheep, or hogs, as infectious, as those caused by these non-polluting germs.

There are many pulmonary complications of germ-parasitic origin of this invasio-non-infectious type, which occur in the lungs, which have not received the attention their merits deserve. In diseases of a specific acute infectious character (exogenous in origin especially), such as typhus abdominalis, the true Swine-Plague, the corn-stalk disease, one of the chief phenomena is a very high fever, and the most essential lesions of such diseases are the extreme parenchymatous changes in the muscles, and dense glandular organs such as the liver and kidneys. Added to these, and of equal importance, are similar changes in the heart-muscles, and the disturbance of the secretive functions of the kidneys. Briefly speaking, the elements of these organs are swollen, their condition, as a whole, is more or less anæmic, due to the pressure of the swollen cells upon the delicate capillary ramifications. These pathological disturbances necessarily lead to pressure, *à vis à frontis*, upon the circulation towards the points of least resistance; that is, to an accumulation of the blood in those organs the structure of which offers the best support to the blood-vessels, and thus favors their distention and engorgement. The two points are, first, the lungs, and next in importance the intestines. The lungs, however, chiefly deserve our attention. This condition of engorgement finds additional support in the weakened propelling power of the heart, due to the parenchymatous disturbance of the muscles. Again, the prostrate position of the individual [in man] in such cases, the inability, or non-desire for movement in both man and animals, increases this condition in the lungs, because the muscles are not called upon to take up any nutrition, and hence all conditions favoring diffusion of the blood are partially stagnated. In such cases what may be termed stagnation-pneumonia (or hypostatic pneumonia—a less correct term) is the physiological result; some might prefer to term it pathological. We will not discuss straws. In such a case we have another very vascular tissue to consider, and that is the mucosa of the bronchioles; this also is engorged, and as in the lung a serous effusion takes place into the alveoli, so in the bronchioles, the same occurs, leading to a complete obstruction of the circulation of the air;

hence atalectosis, then pneumonia; but, in this case, assuming that no micro-organisms are present in the tubes, the cellular plugging up of the alveoli does not begin in those adjoining the tubes, but in those on the extreme limits of the infundibulus. The wonderful provisions of nature are nowhere more marvelously displayed than in the protective function of the cilia of the bronchial mucosa; so long as the mucosa remains comparatively normal, these delicate hairs move all foreign substances, including a surplus of secretion, towards the larynx, whence they are expectorated. This has reference to all forms of micro-organismal life as well. But when the mucosa becomes severely engorged, as in the case in point, the movements of the cilia become heavy and retarded, and when the engorgement of the vessels is so severe as to lead to serous effusion, these movements become completely parralyzed, the natural result being the retention of any foreign elements present at the point where they are caught. This serum and the existing temperature offer the most favorable conditions for the development of any germs which may be present. It can be truly said that in such a case we have a sort of natural "Esmarli Suhe." If such germs are caught at the termination or near there, or along the course of the most delicate bronchioles, they at once commence to develop into colonies, and soon fill up the tube, causing an irritation of the embracing alveolal walls, and set the epithelium of the same into active proliferation, the natural result being broncho-pneumonia. This pneumonia will depend for its character on the specific nature of the germs, which may be simply mechanically irritative in their action, purulent, or gangrenous. According to my experience, the first is the most common variety. In such a case, then, the individual has a pretty poor chance for life. To an already begun stagnation pneumonia is added one of a bronchial type, or vice versa. Again, in such an invasive broncho-pneumonia, the germs soon find their way into the circulation, either by the lymphatics or through penetrating the capillaries, most probably the former, and in such cases we naturally would find a mixture of micro-organisms in the blood.

As said, this occurs in typhus abdominalis. How many times has a physician congratulated himself and his patient

that the "typhoid" was over, only to come the succeeding morning to find the temperature again elevated, the face cyanotic, and the patient breathing rapidly and with difficulty. Surely the diagnosis was correct the previous day, and the prognosis justified? What then has happened?

1st. Stagnation pneumonia.

2d. Friedländer's bacillus or Fränkel's pneumococcus, or some other micro-organism, has been caught in the bronchial tubes, as suggested, and the unfortunate patient is again the object of bacterial attack.

As said so many times, the real pathogenic question is, Are the organisms (or germs) at the bottom of this deuteropathic compliplication simply invasive in character, or has a secondary infection taken place? It is of the utmost prognostic importance that investigators truly inform practitioners which of these two is most likely to be the case.

Though not a a clinician, it would seem as if more attention ought to be given to the movements of the limbs by attendants, or massage treatment in such cases by physicians. Of the value of forced movement in an exactly similar case in Swine-Plague, I can speak most emphatically. It will save an otherwise fatal cases, and not only one case, but will lessen the percentage of mortality in a herd. I have proved this by actual experimentation in two different bunches of hogs inoculated at the same time with the same dose of virus. The ones forced to move several times a day, and as actively as they could, with a whip, all lived. The others, kept closely confined all the time from the day they were inoculated, all died.

It has been said that the larger number of these deuteropathic pulmonary lesions of micro-organismal origin will be found to be simply invasive, and due to mechanical irritation. In Swine-Plague, I know of three distinct micro-organisms which thus cause an invasive broncho-pneumonia, only one of which has any experimental virulence in small animals, and neither of them in swine, on subcutaneous inoculation. In the "Corn-Stalk Disease of Cattle," an unquestionable intestinal infection, several varieties have been found which caused broncho-pneumonia, and, so far as

I have pursued them, have no experimental virulence whatever in any of the usual small animals. The large bacillus (already spoken of) which causes embolic hemorrhage in the kidney in some cases of Swine-Plague, also causes broncho-pneumonia in diseased swine, but is harmless otherwise. The specific disease supplies the field, or opens the way, for the action of these adventitious germs through the disturbances of the circulation. That similar lesions may be due to microörganisms which also find their way into the circulation from the intestinal tract I have no doubt, though I am utterly without experience in that direction.

As a termination to this part of my story I will again repeat: It is absolutely necessary to determine whether these deutero-micro-organisms are simply invasively-mechanical in their action, or which of them also cause secondary infection.

THE SILVER LAKE OF OREGON AND ITS REGION.

BY E. D. COPE.

IT took me three days and a quarter to ride to Silver Lake from Fort Klamath, by an indirect road. We came by Sprague river and Siacan Valley. The former runs into Williamson's River and into Lake Klamath.

Before I left Fort Klamath, the soldiers brought in a splendid lot of trout from these rivers, and I secured several in alcohol. They were the *Salmo purpuratus* Pallas, and I have described their numerous variations in the Philadelphia Academy Proceedings for 1882. The largest weighed twelve pounds.

Next day I started out with a four mule team and wagon with provisions. I rode a cavalry horse, "Jim," a heavily-built gray, with a good outfit of saddle-bags and straps. They gave me an old Klamath chief as a guide, from the Agency near by. This was

old Chaloquin, who was a great fighter in his day. He was a little man, with fat face, prominent eyebrows, retreating forehead and long hair. He was very good natured, smiling broadly on all interesting occasions, and appears to be of a kindly disposition. He was pleased to find that I knew the Klamath names of some fishes, such as Tswam, Xoöptu, Yehnne (large suckers) Metash (trout), etc. He taught me the names of various wild beasts, as Mitap (bear), Yoho (elk), Lok (puma), and various other words. But he couldn't talk English, and I got very little information from him, and he could not understand me. So on the second day out I found a wild young Modoc, Pete by name, who could speak English pretty well, and I hired him instead. I paid the old man off after a friedly palaver, and furnished him with mucky-mucky (provisions) for the return trip.

I found the Corporal Cronk, who had charge of the army property (animals, horses, wagons, etc.) which carried me and my provisions, to be a very inconvenient man. He was very much afraid that some trouble would befall the property, so he bothered me very much. He lost much time by making camp too early in the afternoon of the first day, and I gave him a talking to about it. So the next day he did better, and made a longer ride. I had plenty of time at the first camp, which was on the edge of a grassy meadow, by a splendid stream, clear as glass, which rose from the ground close by. So I went fishing with a mosquito-bar net I got from Mrs. Colonel Whipple, of Fort Klamath, with old Chaloquin holding the other end. We caught small fishes of five or six species, till it was quite dark. Next day we passed a few houses near the Sprague river, forming a place called Yainax. Then, after going eight miles, we forded the river and turned north, and made a camp four miles further, in a little open valley in the woods. The whole country is hilly and mountainous, and covered with tall woods of *Pinus ponderosa*, except the valleys, which are full of good coarse grass. Old Chaloquin carried his bag of wokus for food. This is the roasted and ground seeds of the yellow water-lily, and looks something like cracked wheat. They carry a cup, and mix the wokus in it with water. It swells up

and makes a very agreeable mush, with a taste between farina and coffee.

Modoc Pete started with us on the third day. I was determined to get to Silver Lake on that day, and so I put a can of tomatoes, some hard-tack and some bacon in my saddle-bags to guard against accidents. I left the wagon behind, and rode off through the woods with wild Pete. We soon came across two mule deer, and later three antelope crossed the road before us. Pete called them with a peculiar cry, and they soon turned round and came toward us. Had we had a gun we could have shot one or two of them. Soon after we came down on Siacan Valley, which is ten miles across, and is covered with grass. The creek of that name runs into it, and is lost in a great bed of rushes. Only two houses are in it, and these are close together. The people own numerous cattle.

From this valley we saw a large pointed mountain, N. E., with a naked cone on top. I crossed the first range of hills at its foot, and then got off my horse and had my guide to mark on the ground a sketch of the remainder of the way. I was still twenty miles from Silver Lake. I then sent him back to bring on the wagon, and came on alone. I passed a valley where some horses grazed, but no one lived, and leaving it, I crossed a hill of lava rocks, where I lost the trail, as it did not not show. I found it again, and soon came to a part of the mountain-side where the woods were on fire. This I soon passed, and presently came out of the forest into a great open valley, which seemed to be covered with "sage brush." There were mountains north and west, but east the horizon was like that of the sea. I had reached Silver Lake Valley, which is a branch of the Oregon Desert. Pretty soon the road forked, and I was puzzled. It is necessary to be very careful about traveling alone in a sage brush desert, for one may easily die for want of water. I rode up on a hill and took a better view of the country, but got no satisfaction. The large mountain behind me was evidently an old volcano, and its sides were covered with pumice and vesicular lava, often of a red color; and lava capped the low mountains to the north (Fig. 1.) I chose the principal road, thinking that, right or wrong, it

PLATE XL

SILVER LAKE, LOOKING SOUTH-EAST.

would lead me to water. I followed it, say ten miles, and the sun was just going down when to my delight I came on the banks of a cold stream, which I afterwards found was Silver Creek. Horse and I enjoyed a good drink, and I started again. In a few miles I reached the Eugene road, and found a house. The Indian's sketch had not been correct, for I now knew where I was. I asked for pasture for the horse, but could get no satisfaction, the grass of the creek bottom being fenced in. I, however, crossed the creek, passed through a fence, and followed the creek behind a thick growth of willows. I pastured my horse in good grass, and got a nook near the water for a camp. I hunted wood and made a fire, as it was getting cold, and then I opened my provisions. I cut the can of tomatoes and broke my

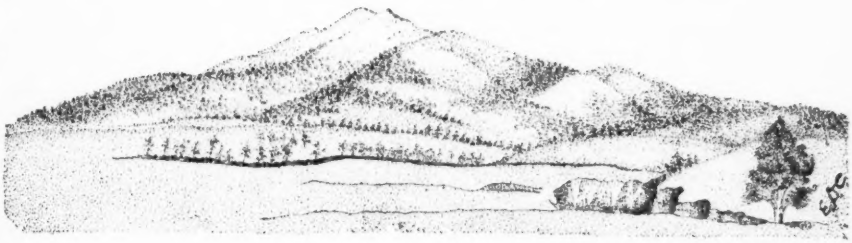


FIG 1.—WINTER MOUNTAIN LOOKING WESTWARD.

hard biscuit in it, and set it on the coals. Then I cut some slices of bacon, and put them on top of the tomato can, which had to serve as a frying-pan. It didn't fry very fast, but finally all was ready, and with a saddle-blanket for a chair, a newspaper for a table, and a biscuit for a plate, I ate a good supper with a great appetite. I had ridden forty-five or fifty miles, and was tired. I soon got into my blankets, but didn't get to sleep as soon as I wished. A pair of small (?) owls took a position near, and cried continually. They were driven off by a pair of huge owls which screamed like a wagon-wheel without grease, horribly, and flew close over my face on a tour of inspection. However, I enjoyed a delightful sleep at last, and woke up early, ate some cold tomatoes, and got on the road. After eight miles through the

sage-brush, I reached the house of Mr. George Duncan, on the shores of Silver Lake. The next day after I arrived, the guide and one soldier came in with a note from the Corporal stating that the wagon had broken down, and they could get no farther! So I hired a man to go and bring on my stuff, and then the soldiers hired him to take their part of the load back to Fort Klamathe

Silver Lake measures about twelve miles long by eight miles wide. It is supplied with fresh water from Silver Creek which enters it from the north-west and has a swampy delta. The *Salmo purpuratus* are numerous in the creek, but they do not enter the lake, owing to the alkaline character of its waters. A smaller fresh stream enters at about the middle of the western shore. The lake is bounded on the west and east by precipitous basaltic bluffs (Plate XL.) On the south the bluffs present their dip edges to the lake, since the general strike is north and south. As I have observed in the lakes further south, i. e., Pyramid Lake, Nevada, and Warner's, Abert and Summer Lakes, Oregon, the basaltic beds dip away to the east from the bluffs which bound the east sides of the lakes, showing that the latter occupy fissures or fractures in the beds, which have a north and south direction. On the north side Silver Lake is bounded by a range of low hills, terminating in a bold flat-topped butte to the east, which is composed of volcanic mud more or less irregularly stratified (Pl. XLI.) A low shore and plain separate this range from the eastern bluffs, and at this point, overflow from the lake reaches a low tract to the eastward, which, when it contains water, is known as Thorne's Lake. It was dry at the time of my visit, (1879). On climbing the bluff which bounds the lake on the west, the observer stands on the edge of a plain which extends to the foot of the ancient volcano which I passed on the way to the lake. It is here seen to form but a single mountain with its foothills, forming a line north and south. It occupies the position of the so-called "Winter Range" of the U. S. War Department maps; but it is rather entitled to be called Winter Mountain than a "range." Its summit is bold, but had no snow on it at the time of my visit (Fig 1). Its slopes are thickly clothed with forests of pine (*Pinus ponderosa*).

PLATE XLI.

SILVER LAKE, LOOKING NORTH.

From the summit of the bluffs on the east, the eye ranges over the sage-brush desert of Central Oregon. Its surface is diversified by hills and bluffs, which have generally one slope, and one precipitous side running generally north and south. The surface was everywhere dotted with the ubiquitous sage-brush (Artemisia), with here and there a generally distorted cedar (Juniperus). This scene extended as far as the eye could reach, being bounded on the north-east by the long, low outline of the Wagontire mountain.

The fauna of the lake interested me, and I was curious to know the species of fishes, if any, which inhabited its alkaline waters. These proved to be all Cyprinidæ, and of but one species; viz.: *Myloleucus formosus* Girard, which I found also in Aberts Lake and Warners Lake.

The only Batrachian which I found was the tree-frog, *Hyla regilla* B. and G., which was quite common near the water's edge. I have never known this species to be taken in trees. Of reptiles the most abundant was the *Uta stanbsuriana* B. and G., which occurs whenever it can sun itself or find concealment on the volcanic rocks. A variety of *Sceloporus undulatus* Harl. was also common; but of other lizards I found none. The two snakes were the red spotted garter snake, *Eutœnia sirtalis pickeringii* B. and G., and the rattlesnake, *Crotalus confluentus lecontei* Hallow. I found one of the latter near the house, and wrapping my hand well in my pocket handkerchief, I clapped it over his head, and transferred him to a bottle of alcohol in short order.

Birds are abundant on the lake. Geese and swans were always in sight, and pelicans and cormorants were common. The grebe *Podiceps occidentalis* Lawr. was to be seen singly or in pairs on the water at all times of the day, and their musical, finely trilled note was one of the commonest sounds of the day or evening. They possess in a high degree the peculiarity of their tribe, that of immediately sinking from view, and of reappearing at a distance after a submerged swim. Of the land birds, the most noteworthy was the *Myiadestes townsendii*. It is the most beautiful songster of the far west, rivaling in this respect its con-

geners of tropical America. Its note is not so loud and varied as that of the Mexican "clarine" (*M. obscurus*), but is sweet and subdued. The favorite position of the bird is on the summit of a dead tree, whence it sallies, flycatcher-fashion, after its insect food. The *Turdus naevius* appeared in small flocks, with the manners and movements of our robin; and the mountain mocker, as I supposed it to be (*Oreoscoptes montanus*), was common in the thickets. The woodpeckers were represented by the *Melanerpes torquatus* Wilson, whose peculiar irregular flapping flight is familiar to all persons who have seen the pine woods of the Rocky Mountains.

The Mammalia to be found about the lake are those common to the region. The antelope, coyote (*Canis latrans*), badger, and skunk were easily found by sight or smell. By far the most abundant order is that of the Glires (rodents). I picked up a dead *Thomomys bulbivorus* near to Duncan's house. In the sage desert west of the house the chipmunk (*Tamias asiaticus quadrivittatus* Say), a small Spermophilus, and four species of rabbits abounded. The Tamias has the habit of climbing up the slender stalks of grasses and other plants for the purpose of feeding on the seeds. In such positions, when their attitudes remind one of a bird rather than of a mammal, they are easily secured. The rabbits inhabit the sage-brush in great numbers. The species are the *Lepus campestris* A. and B., *L. callotis* Wagl., *L. silvaticus* Bachm., and the *L. trowbridgii* Baird. The first-named is the largest, and is the least abundant. It is easily recognized by its light colors and its relative long tail. The jackass rabbit (*L. callotis*) is the most abundant, and is the most important as an article of food. The cotton-tail, *L. silvaticus*, has the same characters as elsewhere, and differs from the two large species in its habit of running into holes. A most curious species is the litttle *L. trowbridgii*, which I first detected in this region, its previously known habitat having been the coast of California. Its color is a uniform bright rufous or rusty, and it appears, when running, to have no tail at all. Its movements are most erratic, dodging suddenly from one direction to another, so that it is very difficult

to shoot. I failed completely to hit one, after many trials, and my identification was based on specimens sent me afterwards by Mr. Duncan.

After remaining for a few days at Mr. Duncan's, there arrived a guest to whom I became under great obligations. This was Mr. Charles Whittaker, the son of Governor Whittaker, of Oregon. Learning that I wished to visit and explore the remarkable deposit of fossil bones known as Fossil Lake, he placed his conveyance, drawn by two fine horses, and his time, at my disposal. Fossil Lake lies about forty miles to the eastward of Silver Lake, in the desert, and the trail through the sage-brush was passable for a wagon. Water could be had by digging, but food for the horses must be carried.

We left the lake by the low pass on the northeast, and, passing by the flat that held Thorne's Lake when it existed, drove to Christmas Lake, our first stopping-place. This is a small body of water of but few square miles in extent, and is excessively alkaline. Its waters have no appreciable effect on the arid shores, which were dry and dotted with the sage-brush almost to its edge. I found abundance of larvæ of dipterous insects, and crustaceans, as Cyclops, in the water; but a rancher who lived near by, told me that it contained no fishes, a statement which I could readily believe. Avosets (Recurvirostra) and stilts (Himantopus), waded in the shallows, feeding, I suppose, on the invertebrate life which I observed. From the rancher I obtained some beautiful obsidian arrow-heads and scrapers which he had found at Fossil Lake.

By early the next evening we had reached the "bone yard." We dug two holes in a low place, one for ourselves and one for the horses, getting clear water, somewhat alkaline to the taste, at a depth of about eighteen inches. We soon had a brisk fire of dry sage-brush; and bacon and mutton, potatoes and canned tomatoes, were soon in condition to satisfy the appetite which only the camper in the dry regions of the West experiences. We rolled up in our blankets, and my last thoughts before entering dreamland were of what I should find on the morrow.

The "bone yard" was found by cattlemen who were looking up stock which had wandered into this forbidden region, and many of the best specimens were carried off by them and lost to science. The first naturalist who visited it was Professor Thomas Condon, of the University of Oregon, at Eugene, who, with the care for scientific research which has always distinguished him, saved many good specimens and brought them home to his museum. One of these was part of the jaws of the remarkable llama, of about the size of a mule, which I called *Eschatius longirostris*. Subsequently my assistant, Mr. Charles H. Sternberg, of Lawrence, Kansas, visited the place, and made what is probably the largest collection ever made there. In this I found three species of llamas, the *Holomeniscus hesternus* Leidy, previously known from California, as large as a camel; and the *H. vitakerianus* Cope, as large as a vicugna, which I dedicated to my friend Mr. Whittaker. The third was a curious species, the size of a camel, which I also found in the collections made by MM. Castillo and Barcena in the Valley of Mexico. I called it *Eschatius conidens*. There were two species of true horses (Equus) both extinct; and a hugh sloth (*Mylodon sodalis*, Cope) as large as a grizzly bear. The mammoth (*Elephas primigenius* Blum.) was represented, together with numerous smaller mammals of species both recent and extinct. There were coyotes, otters, beavers, gophers (Thomomys), voles and rabbits, and the phalange of a bear; but no peccaries, tapirs, raccoons or opossums, which one would find in similar company in corresponding beds in the eastern states. Then there were multitudes of bones of birds and of fishes. These were all of existing genera and often species. I detected a few novelties, as a swan (*Cygnus paloregonus*); a goose, (*Anser hypsibatus*), and a cormorant, (*Phalacrocorox macropus*). One of the most abundant species was a grebe, which I could not distinguish from the one so commonly seen in Silver Lake, (*Podiceps occidentalis* Lawr.). Other species still await determination. Of the fishes, all belonged to the families of chubs and suckers, and several of them to species still living in the Silver and Klamath Lakes.

The next day I set out early to explore the ground. I found it to be a slight depression, embracing perhaps twenty acres, which was devoid of sage-brush, but was dotted with occasional plants of greasewood (*Sarcobatis vermicularis*), a fact due to the presence of water beneath the surface. The latter was, however, perfectly dry, and consisted of a light-colored mixture of sand and clay, or a dried lacustrine mud of volcanic origin. It was perfectly movable by the wind, and of indefinite depth. Fragments of bones and teeth were not rare. The most abundant were those of the large horse, *Equus occidentalis* Leidy, and the *Holomeniscus hesternus* Leidy. I found also bones and fragments of the *Elephas primigenius*, and the greater part of the skeleton of a Thomomys. I obtained, in fact, representatives of most of the species previously discovered, including numerous birds and fishes. All were on or in the loose, friable deposit. Portions of the surface were white with the shells of the *Planorbis* (*Carinifex*) *newberryi* Lea, a species which is still living in Klamath Lake. Scattered everywhere in in the deposit were the obsidian implements of human manufacture. Some of these were of inferior, others of superior workmanship, and many of them were covered with a patine of no great thickness, which completely replaced the natural lustre of the surface. Other specimens were as bright as when first made. The abundance of these flints was remarkable, and suggested that they had been shot at the game, both winged and otherwise, that had in former times frequented the lake. Their general absence from the soil of the surrounding region added strength to this supposition. Of course it was impossible to prove the contemporaneity of the flints with animals with whose bones they were mingled, under the circumstances of the mobility of the stratum in which they all occurred. But had they been other than human flints, no question as to their contemporaneity would have arisen. Similar flints have been found by Mr. W. T. McGee in beds in Nevada, which he regards as of identical age with that of Silver Lake (the "Equus Bed"); but whether diagnostic vertebrate fossils are found at that locality, does not appear to be known. The probability of the association is, however, greatly increased by the discovery, by Mr. Wm. Taylor, of paleo-

lithic flints in beds of corresponding age, on the San Diego Creek, Texas. I append a list of the species so far obtained from the Equus Beds of Silver Lake.

MAMMALIA

Holomeniscus vitakerianus Cope.
" *hesternus* Leidy.
Eschatius longirostris Cope.
" *conidens* Cope.
Equus major Dekay.
" *occidentalis* Leidy.
" *excelsus* Leidy.
Elephas primigenius Blum.
Canis latrans Say.
Lutra ?piscinaria Leidy.
Castor fiber L.
Arvicola sp.
Thomomys bulbivorus Licht.
" *; clusius* Coues.
Mylodon sodalis Cope.

AVES.

Podiceps occidentalis Lawr.
" *californicus* Heerm.
Podilymbus podiceps Linn.
Graculus macropus Cope.
Anser hypsibatus Cope.
" *canadensis* L.
" *albifrons gambeli* Hartl.
" near *nigricans* Lawr.
Cygnus paloregonus Cope.
Fulica americana Gmel.
And numerous other species.

PISCES.

Leucus altarcus Cope.
Myloleucus gibbarcus Cope.
Cliola angustarca Cope.
Catostomus labiatus Ayres.
" *batrachops* Cope.

One day we made an exploration of the desert in the direction of Wagontire Mountain towards the north-east. After traversing the sagebrush for two hours we reached the sandy desert of which we had heard. An apparently endless expanse of sand-dunes extended to the west, the north and the east. These dunes were not conical, but had a sloping side to the south-west, and a perpendicular face to the north-east. As the wind blew strongly from the south-west, the sand slowly crept towards the summit, and then fell in a fine shower to the base below. In this way the dunes constantly shift their position north-eastward till they reach the slopes of a range of hills, where they are banked up so as to be visible at a long distance. The sand I found to be soft and difficult for man and beast. At intervals there are shallow ravines lined with bunches of course grasses. Several species of finches inhabit these places, and feed on the seeds. Among these I occasionally saw the desert Pipilo, *P. chlorurus*. At one of them I found a set of Indian domestic implements; a flat dish and several pestless carved so as to have a portion for the hand separated from the head by a shoulder. All were made of the vesicular basalt, and some of them were colored red, like that found on the slopes of Winter Mountain. As no camp could well have continued there, it appeared that these implements had been left or thrown away. This sandy desert is said to be about twenty-five miles from east to west, and half as wide from north to south.

We left the sand and kept the sage-brush until about twenty-four miles east of our camp. Here I climbed a cliff to view the country. It was composed of the same thinly stratified volcanic mud-conglomerate as the hills that bound Silver Lake on the north. Lizards of the genera Uta and Sceloporus abounded. The scene was impressive from its wild desolation. As far as the eye could reach was the same sage-brush desert, the same waterless region of death. Many a man has entered this region never to escape from its fatal drought, especially during the first days of the overland emigration to Oregon. The Wagontire mountain, whose long and gloomy mass made the northeastern horizon, owes its name to the disastrous fate of one of those trains of

emigrants. Coming from the east, they reached the mountain with parched mouths, and eyes aching from the heat and dust, expecting to find water for themselves and animals. There is no water in this mountain, and the horses gave out in endeavoring to continue their way through its fastnesses. They lay down and died, and nothing remained of the party but a few whitened bones, and the iron tires of the wagon wheels. Many experienced hunters have been lost in this desert, and two years after my visit, one of the oldest rangers of Oregon entered it, and was never heard of afterwards. And it is indeed easy to miss the few small springs that are found at remote intervals in this desolation of one hundred and fifty miles diameter east and west and north and south.

We mounted our horses, and were glad to retrace our steps before darkness should overtake us. We kept along the southern boundary of the sand dunes as a guide, and at last struck our outward-bound trail. To reach our camp was then not difficult, and we were soon busy housekeeping round the camp-fire. After a night's refreshing sleep we returned by the way we came, to Silver Lake. Thence we took the road north to the Dalles of the Columbia, as already described in the NATURALIST for 1888, p. 996.

CHARACTERS AND DISTRIBUTION OF THE GENERA OF BRACHIOPODA.

BY CHARLES W. ROLFE.

(*Based mainly on external characteristics.*)

I. Valves not united by a hinge, but kept in position by muscular action (*a*).

(*a*) Shell structure horny (*b*).

(*b*) Valves nearly equal, shell hatchet-shaped, or quadrate (*bb*).

(*bb*) Beaks equal, projecting, pointed, without a groove between them for the passage of the foot, *Lingula* Brg.

Subgenera:

Forms with the beaks unequal, *Lingulepis* Hall.

Forms with groove, *Lingulella* Salter.

(*b*) Valves unequal, shell rounded or oval, dorsal valve the larger (*c*).

(*c*) Dorsal valve limpet-shaped, smooth or concentrically striated, ventral valve slightly convex, with a rounded or oval opening behind the beak, which does not reach the margin, *Discina* Lmck.

Subgenera:

Forms in which the opening for the foot lies at the posterior end of the furrow, *Orbiculoidea* d'Orb.

Forms in which the ventral valve is flat or concave, and the foramen is narrow and slit-like, *Discinisca* Dall.

(*b*) Valves unequal, ventral valve the larger (*cc*).

(*cc*) Surface smooth, form somewhat triangular, ventral valve high-conical, with a flattened area running

from beak to margin, in the center of which a shallow furrow is impressed, *Acrotreta* Kut.

(*cc*) Surface rough, ventral valve depressed-conical, its beak with a rounded foramen, and a flattened area beneath. Dorsal valve with a curved beak arising from two marginal projections, *Acrothela* Linn.

(*a*) Shell structure horny, or more or less calcareous (*d*).

(*d*) Shell very small (usually 19 mm. or less) (*dd*).

(*dd*) Form long-oval, surface shining, larger valve convex, with a long-pointed beak, smaller valve flat, *Schmidtia* Volb.

(*dd*) Form oval, both valves convex, larger with a short beak, *Leptobolus* Hall.

(*d*) Shell moderate in size, with rounded outlines (*e*).

(*e*) Ventral valve with a marginal sinus, reaching nearly to the beak (*ee*).

(*ee*) Marginal sinus relatively narrow, surface calcareous, with petal-like markings, beak anterior, *Trematis*, Sharpe.

(*ee*) Marginal sinus broad, triangular or semicircular, beak posterior, *Schizocrania*, H. & W.

(*e*) False hinge line straight, nearly or quite equaling the breadth of the shell. *Kutorgina* Bill.

(*e*) False hinge line, when present, short. Shell nearly circular, depressed, smooth, thickened toward the hinge, Valves unequal, the larger with a shallow groove beneath the beak. The central muscle scars converge posteriorly, *Obolus* Eichwald.

(*e*) Resembling Obolus. The central

muscle scars diverge posteriorly, *Obolella* Billings.

(*a*) Shell structure calcareous (*f*).

(*f*) Dorsal valve limpet-shaped, ribbed, ventral less convex (*ff*).

(*ff*) Ventral valve usually adhering to some foreign object. Inner border of both valves rough, *Crania* Ret.

Subgenus.

Free forms, with inner border smooth, *Pseudocrania* McCoy.

(*f*) Both valves convex, the larger with a heavy back, large area, and pseudodeltidium (*g*).

(*g*) Shell circular, or transversely oval, area broader than long (*gg*).

(*gg*) Beak of larger valve high and heavy, that of the smaller somewhat truncated, *Monomerella* Bill.

(*gg*) Beak of larger valve low and heavy, that of the smaller somewhat pointed, *Dinobolus* Hall.

(*g*) Shell somewhat elongated, area longer than broad, beak of larger valve high and heavy, that of the smaller truncated, *Trimerella* Bill.

II. Valves united by a true hinge, shell structure always calcareous, (*h*).

(*h*) Hinge line curved (*hh*).

(*hh*) Beak pierced by a foramen, (*i*).[1]

(*i*) Surface smooth or concentrically striated (*ii*).

(*ii*) Beak closely incurved, surface impunctate. Interior with spires, *Athyris* McCoy.

(*ii*) Beak not closely incurved, *i.e.*, a space between it and the smaller valve. Surface punctate. No spires (*j*).

(*j*) Posterior portion with two

[1] Many young shells have this character, while in adult forms of the same species it is absent.

folds separated by a sinus, on the smaller valve, and a single fold on the larger, or the folds in both valves are replaced by a truncation of the posterior margin. Arm supports reaching not more than one-third the length of the shell, *Terebratula* Llwd.

(*j*) Arm supports long (*jj*).

(*jj*) Both valves convex. Foramen large. Arm-supports united by a loop near the hinge, *Cryptonella* Hall.

(*jj*) Smaller valve usually almost flat, rarely convex. Arm-supports united by two loops which unite posteriorly to form a short, free median plate, *Centronella* Bill.

Subgenera:

Forms with surface ribbed or striated, *Leptocœlia* Hall.

(*ii*) Beak very short. Shell large. Both valves convex, depressed, without fold and sinus, *Meganteris* d'Arch.

(*i*) Surface ribbed or striated (*k*).

(*k*) See Leptocœlia above.

(*k*) Shell punctate, much elongated, without fold and sinus, or spires, *Rensselaeria* Hall.

(*k*) Shell punctate. Interior with spires (*kk*).

(*kk*) Beak closely incurved, no area (*l*).

(*l*) Form more or less elongated. Central ribs narrow. Cardinal plate broad, *Rhynchospira* Hall.

(*l*) Form transverse. Under the beak of the larger valve

a triangular opening, which is filled by the incurved beak of the smaller, *Trematospira* Hall.

(*k*) Shell impunctate (*m*).

(*m*) Apex of spires directed towards ventral valve (*mm*).

(*mm*) Shell concavo-convex, *Cœlospira* Hall.

(*mm*) Shell plano-convex, *Zygospira* Hall.

(*m*) Apex of spires directed towards dorsal valve. Shell plano- or biconvex. Surface with ribs and transverse lines of growth, *Atrypa* Dalm.

(*m*) No spires (*n*).

(*n*) Shell plano- or slightly biconvex. Ventral valve with a broad, deep sinus on its posterior margin, which reaches half-way to the beak. Dorsal with a marginal sinus, *Eatonia* Hall.

(*n*) Shell tranversely oval. Surface with cellular impressions arranged in rows, *Eichwaldia* Bill.

(*hh*) Beak not pierced by a foramen, (*o*).

(*o*) Shell punctate (*oo*),

(*oo*) Shell spherical. Surface smooth or covered with hair-like spines. Beak light, sharp-pointed, with an area beneath, *Nucleospira* Hall.

(*oo*) Surface ribbed. Beak heavy, no area, *Amphigenia* Hall.

(*o*) Shell impunctate (*p*).

(*p*) Beak thin and sharp (*pp*).

(*pp*) Valves nearly equal. Shell transverse, smooth or faintly

ribbed. Small valve with a sinus, large valve with a fold, *Camerella* Bill.

(*pp*) Shell usually more or less triangular, rarely globose or transversely oval. Beak sharp, directed forward, or sharply incurved. Larger valve with a sinus, smaller with a fold, *Rhynchonella* Fisch.

(*pp*) Like Rhynchonella, but the inside of the ventral shell has converging tooth plates, which unite to form a low median septum, and the dorsal valve has a low, trough-like process, and high median septum, *Camarophoria* King.

(*p*) Beak large and heavy (*q*).

(*q*) Surface smooth, or concentrically striated, rarely with indistinct ribs. Form varying from ovoid to transverse. No area. Interior with spires. Ventral valve with two curiously curved plates, called "shoe-lifter processes," *Merista* Guess.

(*q*) Differs from Merista only in the absence of the shoe-lifter processes, *Meristella* Hall.

(*q*) Differs from Meristella in that the two processes which form the loop connecting the spires do not diverge again after uniting, *Meristina* Hall.

(*q*) Form varying from elongate to gibbous or rotund. Surface ribbed, rarely smooth. Ventral valve very much the larger. Beak very large and

prominent. No area. No fold or sinus, *Pentamerus* Sow.

Subgenera.

Forms which have a narrow area in the ventral valve, and a fold and sinus, *Pentamerella* Hall.

Exceedingly short and gibbous forms, having an area in both valves, *Gypidula* Hall.

Forms which have the ventral valve smaller, and less convex, than the dorsal, *Anastrophia* Hall.

See also Amphigenia above, and Spiririferina below.

(*h*) Hinge line straight (*r*).

(*r*) Shell concavo-convex (*rr*).

(*rr*) Surface spinose, especially along the hinge (*s*).

(*s*) Large valve very convex, or abruptly bent "knee form." Beak large, abruptly incurved. Smaller valve more or less concave. Area linear or absent. Hinge toothless, *Productus* Sow.

Subgenera.

Forms with a low area on both valves, and hinge teeth, *Productella* Hall.

Forms with a high area on the ventral valve. Hinge toothless, *Aulosteges* Helm.

(*s*) Shell broadly transverse. Beak not prominent. Low area on both valves. Spines along hinge, *Chonetes* Fischer.

(*rr*) Surface not spinose (*ss*).

(*ss*) Shell semicircular or transverse. Beak not prominent. Area of the larger valve low, with a triangular opening beneath the beak. No deltidium. Area of smaller valve linear or absent, *Tropidoleptus* Hall.

(*ss*) Shell semicircular, often a little longer than broad, flat, sometimes abruptly near the posterior third, widest at hinge. Both valves with an area, that of the ventral slightly larger, with a small triangular area closed by a deltidium. Beak not prominent. Hinge plain, *Strophomena* Blainv.

Subgenera.

Forms with crenulated hinge, *Strophodonta* Hall.

Small, more convex forms, varying from transverse to nearly semicircular, *Leptæna* Dalm.

(*ss*) Shell varying in form and convexity between Strophomena and Orthis. Ventral valve with a relatively high area, pseudodeltidium, and prominent, often recurved beak. Dorsal valve with a linear area, *Streptorhynchus* King.

Subgenus.

Biconvex forms, with an exceedingly high area, and coarse rounded ribs, separated by angular depressions, *Meekella* W. & St. J.

(*r*) Shell biconvex (*t*). (The convexity of the smaller valve sometimes slight).

(*t*) See Streptorhynchus and Meekella above.

(*t*) Shell depressed, nearly flat, radially folded. Valves nearly equal, the larger with an area, and strongly hooked beak, which is closely incurved. No spires, *Stricklandia* Bill.

(*t*) Form quadrate, varying from semicircular. No internal spires (*tt*).

(*tt*) Convexity of the smaller valve

sometimes slight. Both valves with an area and foramen. No deltidium. Area not striated. Hinge line usually less than breath of shell. Sinus and fold usually absent, rarely prominent, *Orthis* Dalm.

Subgenera.

Shell two-lobed through the presence of a sinus in each valve, *Bilobites* Lin.

Very convex forms, with hinge line often exceeding the breadth of the shell, and a prominent sinus and fold, *Platystrophia* King.

(*tt*) Shell with a wide area, foramen, and pseudodeltidium in each valve, *Orthisina* d'Orb.

(*tt*) Larger valve pyramidal. Otherwise Orthis-like, *Skenidium* Hall.

(*t*) Shell nearly spherical, punctate thin hinge line very short. Area small. Beak recurved, *Syntrielasma* M. & W.

(*t*) Shell triangular, varying towards circular. Sinus and fold usually prominent. Hinge line often exceeding the breadth of the shell. Beak usually more prominent than in Orthis. Area in both valves, that in the ventral larger, and striated with horizontal and vertical lines. Spires present, *Spirifer* Sow.

Subgenera.

Forms with punctate shell (*v*).

(*v*) Surface finely spinose. Foramen covered by a deltidium. Hinge line sometimes curved, *Spiriferina* d'Orb.

(*v*) Hinge line long and straight. Larger valve with a broad area,

a narrow triangular fissure partly closed by a deltidium, and a broad median sinus. Smaller valve without area, *Syringothyris* Winch.

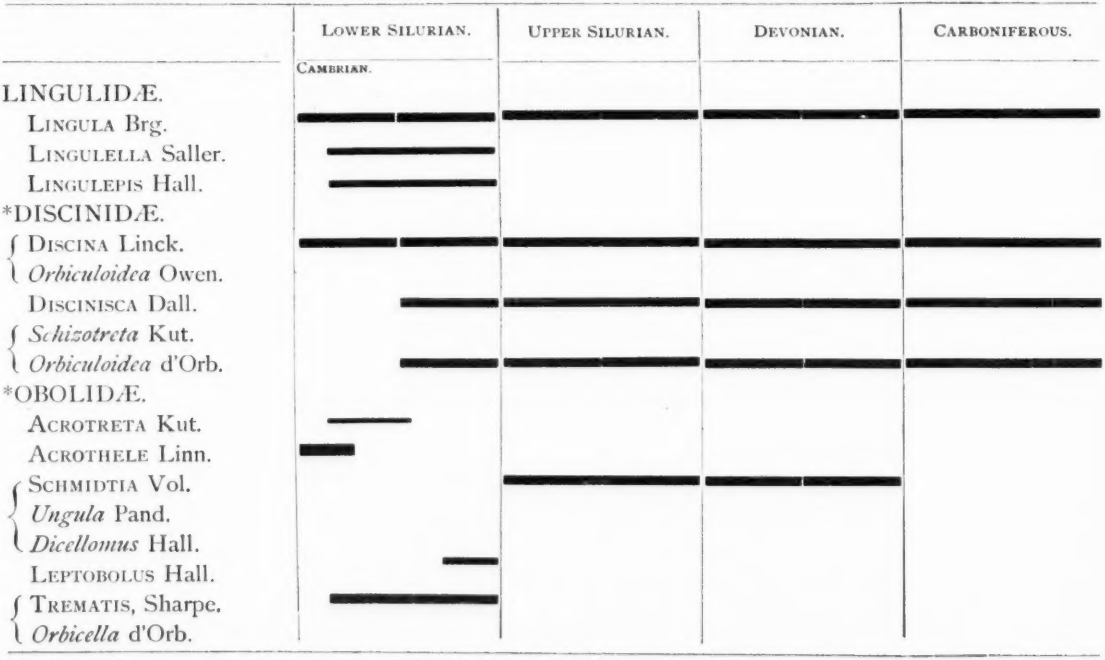
(*v*) Punctate shells which closely resemble Cyrtia, *Cyrtina* Dav.

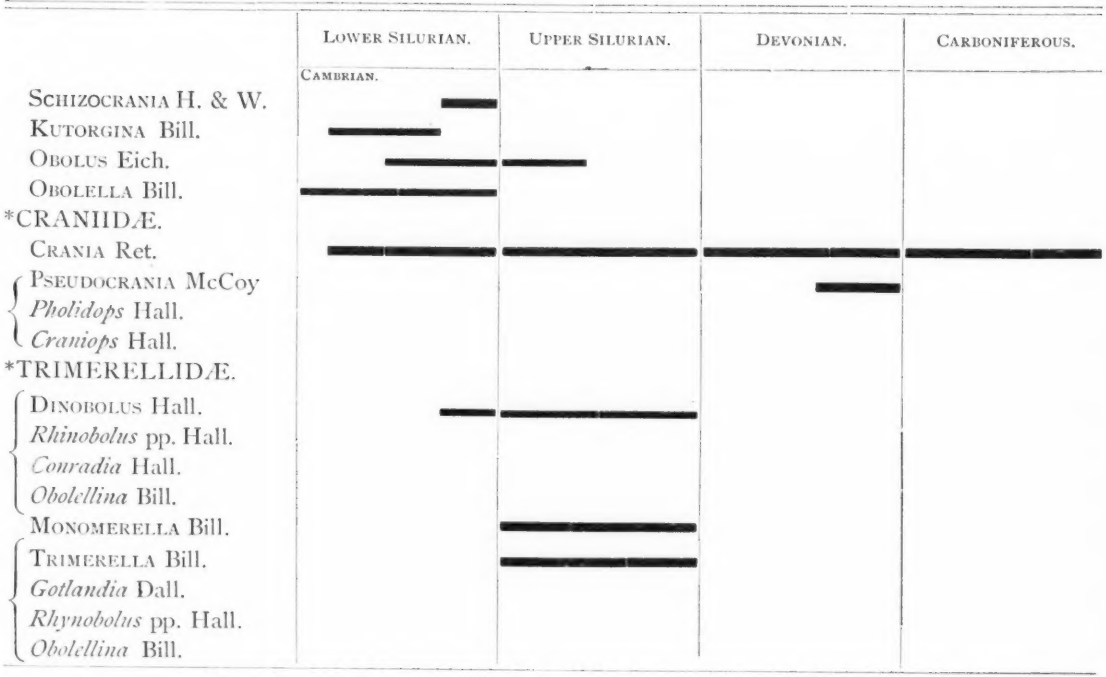
Forms with impunctate shell (*vv*).

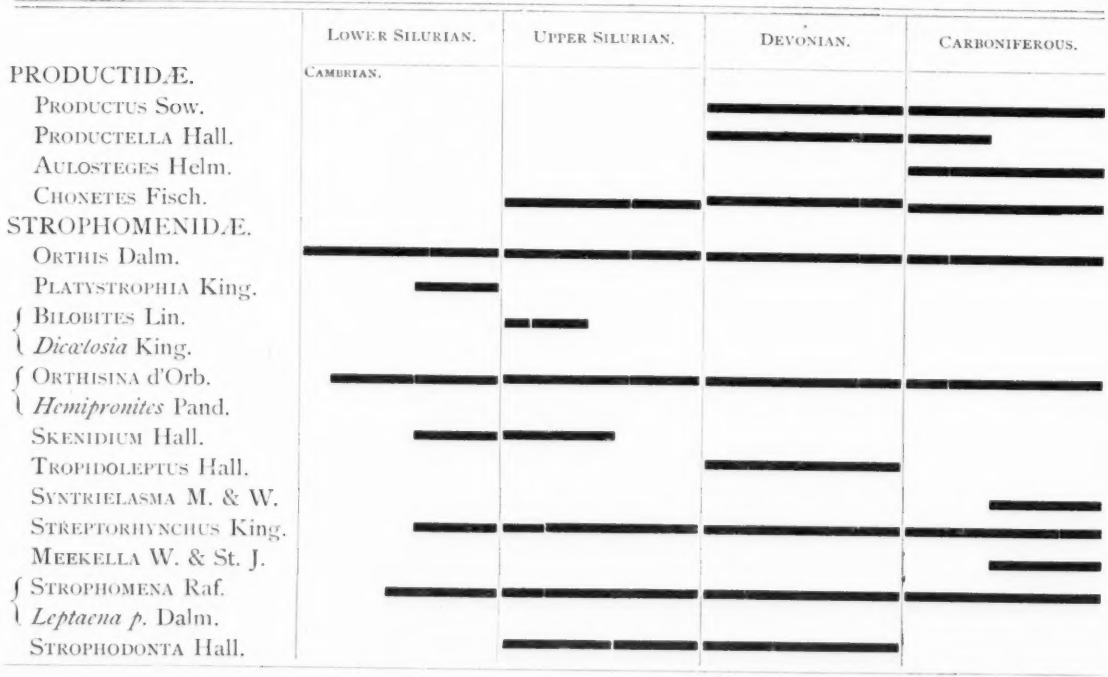
(*vv*) Shell gibbous. Surface smooth or finely striated. Ventral valve very convex, with a prominent incurved beak. Dorsal flat, or much less convex, *Martinia* McCoy.

(*vv*) Surface ribbed. Larger valve high pyramidal, with a large, flat, triangular area, and a median fissure closed by a pseudodeltidium. Smaller valve convex, *Cyrtia* Dalm.

Synonymy and Distribution.




LOWER SILURIAN.
UPPER SILURIAN.
DEVONIAN.
CARBONIFEROUS.
CAMBRIAN.
SCHIZOCRANIA H. & W.
KUTORGINA Bill.
OBOLUS Eich.
OBOLELLA Bill.
*CRANIIDÆ.
CRANIA Ret.
PSEUDOCRANIA McCoy
Pholidops Hall.
Craniops Hall.
*TRIMERELLIDÆ.
DINOBOLUS Hall.
Rhinobolus pp. Hall.
Conradia Hall.
Obolellina Bill.
MONOMERELLA Bill.
TRIMERELLA Bill.
Gotlandia Dall.
Rhynobolus pp. Hall.
Obolellina Bill.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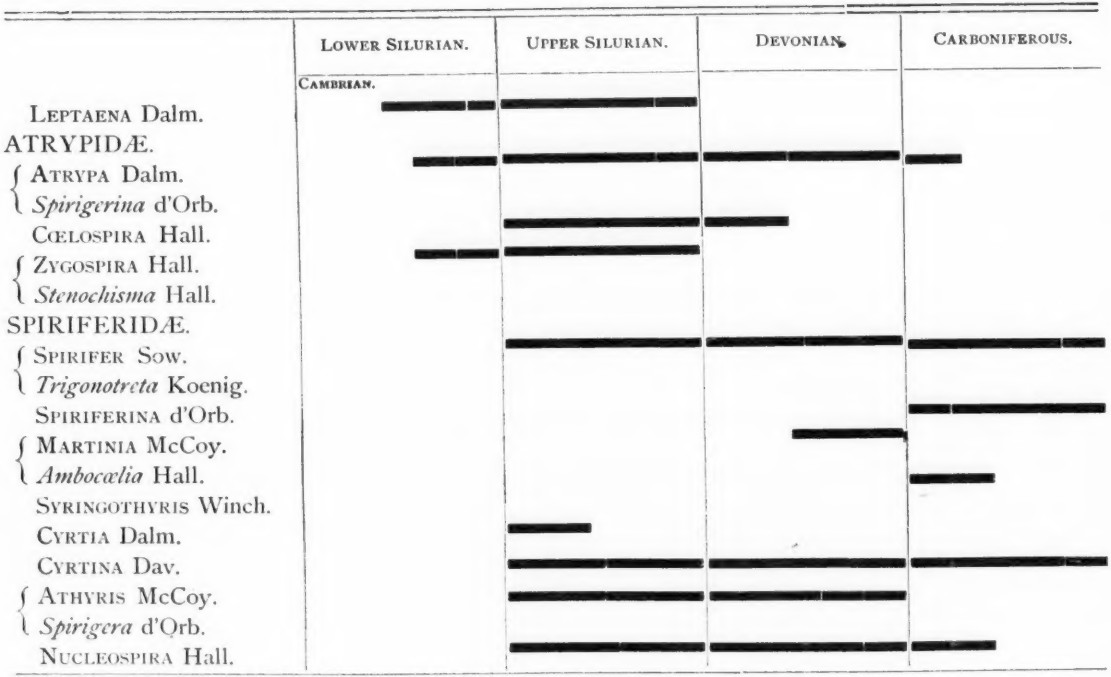
UPPER SILURIAN.
DEVONIAN.
CARBONIFEROUS.
CAMBRIAN.
PRODUCTIDÆ.
PRODUCTUS Sow.
PRODUCTELLA Hall.
AULOSTEGES Helm.
CHONETES Fisch.
STROPHOMENIDÆ.
ORTHIS Dalm.
PLATYSTROPHIA King.
BILOBITES Lin.
Dicœlosia King.
ORTHISINA d'Orb.
Hemipronites Pand.
SKENIDIUM Hall.
TROPIDOLEPTUS Hall.
SYNTRIELASMA M. & W.
STREPTORHYNCHUS King.
MEEKELLA W. & St. J.
STROPHOMENA Raf.
Leptæna p. Dalm.
STROPHODONTA Hall.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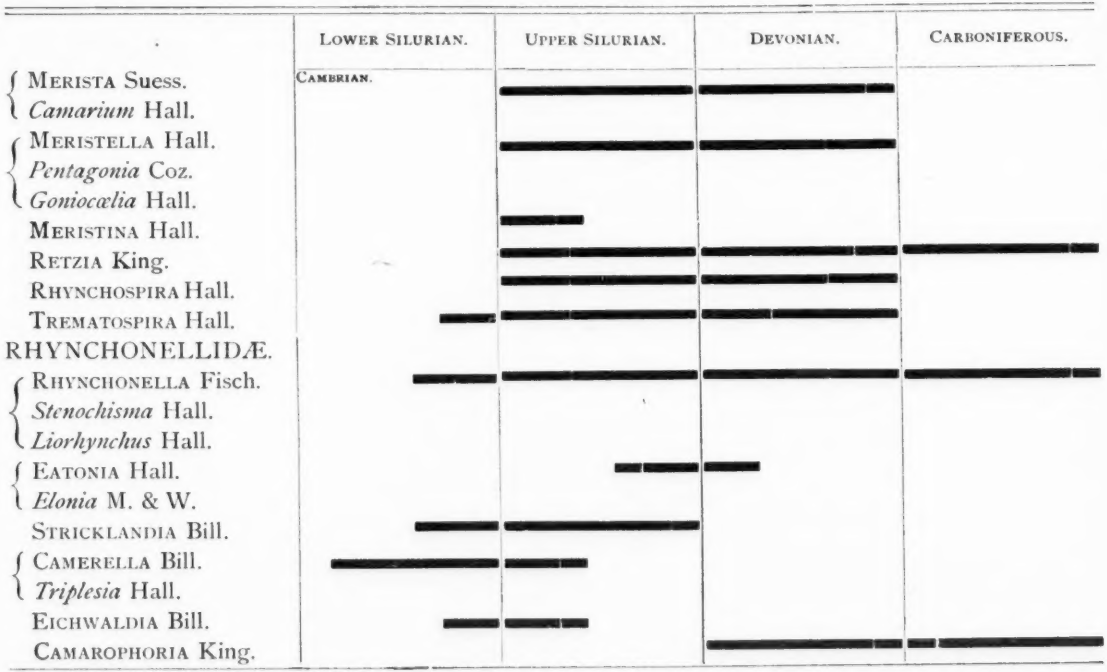
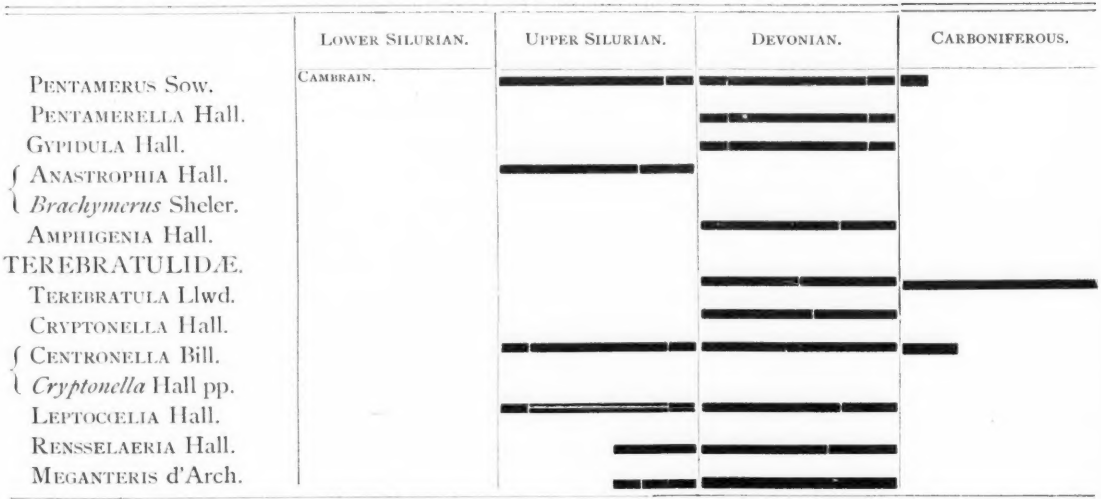
UPPER SILURIAN.
DEVONIAN.
CARBONIFEROUS.
CAMBRIAN.
LEPTAENA Dalm.
ATRYPIDÆ.
ATRYPA Dalm.
Spirigerina d'Orb.
CŒLOSPIRA Hall.
ZYGOSPIRA Hall.
Stenochisma Hall.
SPIRIFERIDÆ.
SPIRIFER Sow.
Trigonotreta Koenig.
SPIRIFERINA d'Orb.
MARTINIA McCoy.
Ambocœlia Hall.
SYRINGOTHYRIS Winch.
CYRTIA Dalm.
CYRTINA Dav.
ATHYRIS McCoy.
Spirigera d'Orb.
NUCLEOSPIRA Hall.


LOWER SILURIAN.
UPPER SILURIAN.
DEVONIAN.
CARBONIFEROUS.
CAMBRIAN.
MERISTA Suess.
Camarium Hall.
MERISTELLA Hall.
Pentagonia Coz.
Goniocælia Hall.
MERISTINA Hall.
RETZIA King.
RHYNCHOSPIRA Hall.
TREMATOSPIRA Hall.
RHYNCHONELLIDÆ.
RHYNCHONELLA Fisch.
Stenochisma Hall.
Liorhynchus Hall.
EATONIA Hall.
Elonia M. & W.
STRICKLANDIA Bill.
CAMERELLA Bill.
Triplesia Hall.
EICHWALDIA Bill.
CAMAROPHORIA King.


LOWER SILURIAN.
UPPER SILURIAN.
DEVONIAN.
CARBONIFEROUS.
CAMBRAIN.
PENTAMERUS Sow.
PENTAMERELLA Hall.
GYPIDULA Hall.
ANASTROPHIA Hall.
Brachymerus Sheler.
AMPHIGENIA Hall.
TEREBRATULIDÆ.
TEREBRATULA Llwd.
CRYPTONELLA Hall.
CENTRONELLA Bill.
Cryptonella Hall pp.
LEPTOCŒLIA Hall.
RENSSELAERIA Hall.
MEGANTERIS d'Arch.

RECENT LITERATURE.

Dr. Ph. J. J. Valentine on the Portuguese Discovery of Yucatan.—In view of the coming Centennial, memoirs and treatises referring to the achievements of the immortal Genoese will be eagerly sought for, and be thankfully accepted by the learned public at large. We wish that all the publications belonging to this branch of history might be conceived in so interesting a way as is the memoir of Dr. Valentine, which was printed in the "Bulletin of the American Geographical Society of New York," containing 83 pages, with several maps. The title is "The Portuguese in the Track of Columbus," (1493). It was issued in four sections, running from December, 1888, to September, 1889. The author brings to light the hitherto unknown fact, that immediately after the return of Columbus from his first voyage, Joam II., King of Portugal, secretly dispatched a fleet of four vessels to the islands seen and occupied by the discoverer, enjoining the commander, Almeïda, to push on in the direction of Columbus' "boasted waterway" to India. Following up the given orders, the coast of Yucatan was struck, and a map of it was drawn, embodying pretty correctly all the peculiarities of this three-coasted peninsula. So well was this discovery kept secret by the Crown of Portugal, that the Spaniards, when striking the coast of Yucatan in 1518, really believed they had found a land never trod upon previously by any European individual.

The documentary evidence for the above statement is derived by the author from a correspondence between King Ferdinand and Columbus, and is of but recent publication. As to the cartographic evidence, it is drawn from a large Portuguese *Carta Mundi*, the entries of which do not reach farther than to the year 1501. This chart was discovered in the archives of the Duke of Modena, by Mr. Henry Harrisse, in the year 1884, and without the least doubt it is the same chart that served the editors of the atlases of 1508, 1513 and 1520 as a prototype for the first sketches ever made of the American Continent.

In Section I. the author shows that although intending to do so, Columbus never actually drew a chart that exhibited a summary of his discoveries. In Section II. the story of the expedition of the four Portuguese caravels is given, with additional extracts giving King Ferdinand's correspondence with Columbus on this particular subject. In Section III. the author gives a general survey of the great oceanic chart, the Portuguese Imago Mundi. Under the head of *Stellæ Maris*, he dis-

cusses in Section IV. the entry on the chart of three naval stations made by the Portuguese cartographer upon this chart,—a central one on the island of Saint Yago (Cape Verde Islands), a second near the Island of Brazil (Coast of Venezuela), and a third near the Island of Andros (Bahama Archipelago). In Section V. the reader is invited to direct his attention toward a very peculiar coast-line, drawn west of the Island of Cuba, and running from South to North, and given the correct reading of twenty-two names inscribed upon this coast, which names in the above-mentioned first sketches of America had been written in a way challenging sound interpretation, and which names now, on the original chart, come forth in full linguistic purity. Two of these names are those of two Portuguese dignitaries, and personal friends of King Joam II., with whom Columbus, a shipwrecked man, had conversed when arriving at Lisbon. Two other names are those of Cozumel and of Campeche, names known to appertain to ancient as well as to modern Yucatan. The circumstance that the three coasts of the peninsula were straightened out to one single line by the draughtsman of the chart is satisfactorily explained. In Section VII., "Identifications," the author shows that when comparing the characteristics proper to the physical features of the three coasts of Yucatan, they will be found to tally upon both the Portuguese and the modern chart, and that all of them present themselves in their natural order of succession.

Unfortunately, Dr. Valentine's article was not published all at once, but at long intervals.—A. S. GATCHET.

Schroeter's Fungi of Silesia.[1]— The third volume of Dr. Ferdinand Cohn's *Kryptogamen Flora von Schlesien* is to be devoted to the Fungi, which Dr. Schroeter is to elaborate. Of this work, begun in 1885, and issued in "Lieferungen" from time to time, Part I. is now complete. The author gives ninety pages of general description and introductory matter, in which (1) the history of fungology in Silesia, (2) the distribution of fungi in Silesia, (3) the general morphology and biology, and (4) the system of classification of the fungi, are discussed.

Bock appears to have been the first to catalogue the fungi of the region included in Schroeter's book: he enumerated twelve species in 1546. Cæsalpinus, in 1583, and Porta, in 1592, enumerated about twenty fungi, while Clusius, in 1601, brought the number up to one hundred and two species, representing some forty-seven genera. Little

[1] *Die Pilze Schlesiens.* Bearbitet von Dr. J. Schroeter. Erste Hälfte, Breslau, 1889. J. U. Kern's Verlag (Max Müller). 814 pp., 8vo.

more was done until the time of Linnæus, when the names of Batsch, Schaeffer, and Tode appear, and still later (1801), Persoon. During the present century the investigators of the fungi have been rapidly increasing in numbers.

In discussing the distribution of fungi, Schroeter states that about 1885 *Tilletia lævis* Kuhn (= *T. foetens* [B. & C.] Trelease) was first found at Breslau, and that previous to 1870 *Puccinia sorghi* Schw. was not known to him to occur in Silesia. The present wide distribution of both these fungi makes these facts very interesting.

It is interesting also to find that, in discussing the relationships of the different groups, Schroeter regards the teleutospore of the Uredineæ as an ascus containing one or more spores, the ascus-membrane fitting tightly over the spores. His statement of his view is given below in a purposely literal translation:

"The Uredineæ stand in close relationship to the typical Ascomycetes, as is undoubtedly generally recognized from the investigations of Tulasne and De Bary. Indications of this fact are furnished by the various fruit-forms, among which are noticeable the spermogerm and stylospore layers (uredo-fruit) that appear in the Ascomycetes. The Æcidia have hitherto been regarded as the analogues of the Sporangium-fruits. I believe that this view can not be maintained, but that these analogues are plainly to be recognized in the teleutospore-fruits. In these latter is found the characteristic, definitely-fixed spore-member, which (barring occasional variations owing to the stunting of individual spores) appears as a dual (*Puccinia, Gymnosporangium,*) or multiple of the same (*Phragmidium, Coleosporium,*) unless there is but one spore developed, as is the case with *Uromyces* and *Melampsora.* In many cases (very plainly in *Puccinia asphodeli,* of the Mediterranean flora) the structure of the so-called spore-divisions is easily seen to be of the nature of endogenous spores, even in the ripe spores; it is also more or less plainly to be distinguished in *Phragmidium,* especially in the young spores. In all cases, the membrane of the spore fuses with that of the mother cell, yet in such a way that frequently it can be recognized as a separate hull."

This view is identical with that set forth by the writer hereof in 1880.[3]

Schroeter divides the fungi into three divisions or series, viz.: Myxomycetes, Schizomycetes, and Eumycetes; each of which is again subdivided into orders and families. The Myxomycetes contain three orders, viz.: Acrasiei, Myxogasters, and Phytomyxini. The treatment of the Schizomycetes is essentially identical with Cohn's,

[3] Botany for High Schools and Colleges. New York. p. 315.

form-species and form-genera being described as species and genera. Three orders are recognized, viz.: Coccobacteria, Eubacteria, and Desmobacteria.

The orders of the Eumycetes are considered by Schroeter to have relationship indicated by the following disposition:

1. Chytridiei.
2. Zygomycetes.
   Sub-ord. Mucorini.
   Sub-ord. Entomophthorei.
3. Oomycetes.
4. Ascomycetes.
5. Uredineæ.
6. Auriculariei.
7. Basidiomycetes.

In the treatment of these orders, in the body of the book, the Protomycetes and the Ustilagineæ are inserted after the Oomycetes, and the Ascomycetes and imperfect fungi are placed after the Basidiomycetes. The Peronosporacei are divided into seven genera, viz.: Pythium, Cystopus, Phytophthora, Sclerospora (including but one species, the *Peronospora graminicola* of Saccardo), Plasmopora (including *Peronospora nivea* Unger, *P. obducens* Schr., and others), Bremia (including *Peronospora gangliformis* of De Bary), and Peronospora, the latter still containing no less than 44 species, although considerably reduced, as indicated above.

The Agaricacei are referred to many genera, the usual sub-genera of Agaricus being raised to generic rank. This gives us the name *Psalliota campestris* (Linn.) Schröt. for the common mushroom hitherto known as *Agaricus campestris*. The genus Agaricus, as thus indicated, contains 171 Silesian species.

In glancing over the pages we notice that the familiar *Schizophyllum commune* of Fries must give way to *S. alneum* (Linn.) Schröt.

So, too, our well-known *Lycoperdon giganteum* (the giant puff-ball) is to be known hereafter as *Globaria bovista* (Linn.) Schröt.

A most useful host-index is included in the volume, which is provided with full generic and specific indexes. The next volume will include the Ascomycetes and "Imperfect fungi."—CHARLES E. BESSEY.

The Scientific Papers of Asa Gray.[1]—It was fitting that his colleague should edit the scattered papers of the master whose departure the world has not yet ceased to mourn. That the selection of an editor was a wise one is proved by the volumes before us. The mass of material was, as the editor says in the preface, "overwhelming," and the task of selection must have been a most difficult and embarrassing one. When we are told that "more than eleven hundred bibliographical notices and longer reviews were published by Professor Gray in different periodicals," we may realize how hard a task was given the editor in the selection of those to be republished and those to be left. Still more difficult was the task of making the selection present as far as possible "a history of the growth of botanical science" during the past fifty years. The success of the editor in spite of these difficulties is most gratifying.

The reviews begin with "Lindley's Natural System of Botany," published in 1836. It gives one an idea of how the world of science has moved when we read arguments for the natural system. Some of the reviewer's reflections upon a class of botanists still by no means extinct will bear repetition: "A somewhat larger number may perhaps be found in this country who admit the importance and utility of the natural arrangement in the abstract, but decline to avail themselves of the advantages it affords in the study of plants, because, forsooth, it is too much trouble to acquire the enlarged views of vegetable structure which are necessary for the application of its principles." Verily, the indolent conservatism of half a century ago was not different from that of to-day!

In the notice of Endlicher's "Genera Plantarum," we have the following paragraph: "It commences, like the 'Genera Plantarum' of Jussieu, with the plants of the simplest or lowest organization (Thallophyta, Endl.); a plan which is now the most common, and perhaps the most philosophical, but which is attended with many practical inconveniences to the tyro." This is the view held by Dr. Gray throughout his life, and it is doubtless largely through his influence that the reverse plan has become so popular in botanical teaching in this country.

We would like to quote, if space permitted, from the review of Agassiz's "Nomenclator Zoölogicus," some of the pointed remarks which are not yet out of date, and which reappear long after in the

[1] SCIENTIFIC PAPERS OF ASA GRAY, selected by Charles Sprague Sargeant. Vol. I., Reviews of Works on Botany and Related Subjects, 1834–1887, pp. viii., 398. Vol. II., Essays; Biographical Sketches, 1841–1886, pp iv., 504. Boston and New York, Houghton, Mifflin & Co. The Riverside Press, Cambridge, 1889.

review of "De Candolle's Phytographie." In the notice of Curtis's "Woody Plants of North Carolina," the reviewer says: "We quite like to see the popular names put foremost, but would suggest that the botanist who does this should lead as well as follow the indigenous nomenclature so far as to correct absurd and incongruous local names, and introduce right and fitting ones as far as practicable;" and, in referring to the popular character of the book, "We are well aware how much easier it is, and how much better in such cases, to fit your book to its proper readers than to fit the readers to it."

The Essays of the second volume, fourteen in number, make us wish that more had been selected for publication. Here we have: "Notes on a Botanical Excursion to the Mountains of North Carolina," "The Longevity of Trees," "Do Varieties Wear Out, or Tend to Wear Out?" "A Pilgrimage to Torreya," "Characteristics of the North American Flora," etc., etc., all of which are full of interest.

The biographical sketches constitute in their present form an important contribution to the history of botany during the present century.—CHARLES E. BESSEY.

General Notes.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—An article full of interesting observations on the alteration of olivine and augite, is by Dorr,[2] who describes the minettes, kersantites and melaphyre dykes in the neighborhood of Dresden, in the Plaunischer Grund. The three rocks cut syenite, and the first two contain inclusions of it. The olivine of the minette is frequently twinned parallel to $P\breve{\infty}$. It has often changed into pilite and talc, and has, in some cases, been pseudomorphed by quartz. The augite has given rise to pseudomorphs of calcite and quartz, and has undergone alteration into biotite under the influence of dynamo-metamorphism. The biotite, some of which is primary, has been enlarged since the solidification of the rock. It is intergrown with orthoclase in some instances, and alters into chlorite and talc, with the addition of rutile in the minettes, and of anatase in the kersantite. The quartz inclusions in both rocks are surrounded by rims of green augite, while inclusions of orthoclase have altered on their edges to biotite when solution has not been completed. When the fusion has proceeded to completion, no evidence of the former existence of the inclusion is present. The paper is well illustrated, and it contains full literature of the most important points discussed.—— Bonney[3] has made two traverses across the crystalline rocks of the Alps with the object of determining their age. In the course of his article on the subject he describes the microscopical character of the gneisses, mica-schists and clay slates found there. A mica-schist from the Octroi de Vizille consists of mica, cyanite and quartz. The cyanite occurs in irregular-shaped grains, containing tiny flakes of brown mica, black granules and minute belonites. Calci-mica-schists from the eastern side of the Cottian Alps are composed of granular quartz, calcite, and brown and white mica. These are supposed to have originated from sediments. The other rocks described present no peculiar features, except that they all exhibit the effects of crushing

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Miner. und Petrog. Mitth.*, XI., p. 16.

[3] *Quart. Jour. Geol. Soc.*, Feb., 1889, p. 67.

and re-cementing.——Analyses of phyllites, amphibolites, porphyroids, quartzites, and a few minerals from interesting localities in Belgium and the Ardennes, France, form the basis of an instructive article by Klement.[4]——Collins,[5] in an article on the nature and origin of clays, divides these into clays produced in situ by the alteration of feldspar, and derived clays. The former are purest, and include the china clays. Derived clays are impure, in consequence of the admixture of unaltered feldspar and other minerals. The composition of a pure clay is about as follows:

SiO_2	Al_2O_3	Fe_2O_3	Alk	MgO	CaO	Org. Mat	H_2O
47.82	41.43	.30	.39	.29	.11	.10	10.50

When washed, it contains no scaly or flaky particles, but possesses a uniform texture. Its composition corresponds very nearly to the formula $Al_2(HO)_6SiO_2 + Al_2O_3\,3SiO_2$. In discussing the origin of clays, Collins states that the theory based upon the action of carbon dioxide on feldspar is untenable. He inclines to the von Buch and Daubrée view of the action of solutions containing salts of fluorine or fluosilicic acids.——Teall[6] has discovered long, acicular, colorless, rutile needles in several of the clays of England. This observation is interesting from the fact that Thurach was not able to find the mineral in the clays which he examined, although it is well known as a constituent in clay slates under the name "Thonschiefer-nädelchen."——Among some notes on a few rocks from the Salzburg and Tyrolese Alps, Cath. ein[7] describes an eclogite in which the garnets are changing to hornblende. He also mentions an amphibolite in which are light-colored apparently prismatic crystals, which, under the microscope, are resolved into aggregates of epidote and zoisite. The author regards them as pseudomorphs of the former mineral after the latter. A second specimen of amphibolite contains garnets that are gradually changing into biotite. ——Mr. Merrill[8] describes in detail the peridotite[9] from Deer Island, Maine, in which augite enlargements have been discovered. The rock is a picrite, composed of olivine, augite and various iron oxides. The enlargement of the augite seems to have resulted in some way through the alteration of olivine, as the added material is found extending from

[4] *Bull. Mus. Soc. Roy. de Hist. Nat. de Belg.*, t. V., p. 59.

[5] *Miner. Mag.*, Dec., 1887, p. 205.

[6] *Min. Magazine*, 1887, Dec., p. 201.

[7] *Ver. d. K. K. geol. Reichs.*, No. 8, 1889.

[8] *Proc. U. S. Nat. Mus.*, 1888, p. 161.

[9] *Amer. Jour. Science*, May, 1887, p.

the augite only into the altered olivine, along what were probably the cleavage cracks of the fresh mineral.——A specimen of the variety of picrite known as scyelite was discovered by Bonney[10] in the island of Sark, British Channel. It consists of serpentinized olivine, altered augite, bleached mica, some of which exhibits a banded twinned structure, one set of bands extinguishing parallel to the cleavage of the mineral, and the second 18° from this. The rock was not found in place.——The separation of large quantities of apatite from the gneiss of Freiberg and the granite of the Kinzigthal has given Steltzner[11] the opportunity of comparing their composition. He found that the apatite from the gneiss corresponds to the formula $10Ca_3(PO_4)_2+3CaF_2$, while that from the granite accords better with the formula $13Ca_3(Po_4)_2+4CaF_2$.

Mineralogical News.—A number of yellow grains of monazite [(Ce, La, Di) PO_4] having been found in the sands from various localities in Brazil, more particularly in the neighborhood of Rio Janeiro and in the diamond fields, Mr. Derby[12] has sought for the mother rock containing the mineral, and has found it in the biotite-gneiss, granites and syenites of the region. His method of operation was to grind into powder a large quantity of the decomposed rock and wash it in the manner made use of in the search for alluvial gold. A full description of the mineral and the rocks in which it occurred is promised in due time.——Measurements of fifteen crystals of *polybasite* from five different localities afford Miers[13] data for the determination of the axial ratio of this mineral with some degree of accuracy. He finds it to be $a:b:c = 1.7262:1:.6344$. Crystals with an apparently hexagonal habit are in reality twins, with the twinning plane ∞P. The examination of eighteen crystals of *aikinite* from Beresovsk, Urals, affirms the conclusion that the mineral is orthorhombic. The prismatic angle is 82° 22.——Among a few minerals from the Ardennes and Belgium analysed by Klement[14] attention may be called to a chromiferous *mica*, occurring in small flakes on vein quartz from Salin-Chateau, Belgium. The lamellæ are non-elastic, but their composition approaches that of muscovite, viz.:

Si_2O	Al_2O_3	Cr_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Li_2O	H_2O
45.68	34.17	.84	2.35	.27	3.84	4.47	2.23	tr	4.65

[10] *Geol. Mag.*, Mar., 1889, p. 109.
[11] *Neues Jahrb. für. Min.*, etc., 1889, I., p. 265.
[12] *Amer. Jour., Sci.*, Feb. 1889, p. 109.
[13] *Miner. Magazine*, May, 1889, p. 204.
[14] *Bull. Mus. Roy. de Hist. Nat. de Belg.*, V., p. 59.

A manganiferous *chlorite* from Villsalen contains

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	H_2O
27.13	24.70	5.84	9.72	1.98	20.52	11.35

——Upon comparing the loss of arsenic consequent upon the heating of *löllingite* and *arsenopyrite*, Loczka[15] concludes that the latter mineral is a compound of $FeAs_2 + FeS_2$, and that its decomposition by heat is effected as follows:

(1) $FeS_2 + FeAs_2 = FeS + S + FeAs_2$; (2) $FeAs_2 + S = FeS + 2As$.

——The mean of a lot of analyses of *pinite*[16] from the conglomerate of Boston yields.

SiO_2	Al_2O_3	Fe_2O_3	K_2O	Na_2O	CaO	MgO	H_2O	Loss
48.16	36.23		8.65	.39	.28	.91	4.51	.38

Meteorites —Of very considerable interest to students of meteorites are two recent articles by Huntington. It will be remembered that this writer, in 1886, showed[17] that the Widmanstättian figures and Neumann lines on the etched surfaces of meteoric irons are sections of planes of crystalline growth parallel to the cube, dodecahedron and octahedron, which planes are also the planes of easiest cleavage for meteoric iron. In one of his recent papers[18] he shows that in the case of the Butcher meteroite (Coahuila, Mex.) the cleavage is parallel to the faces of an interpenetration cube. The surface produced by fracture of this meteor is very different from the fracture surface of the Saltillo iron, and therefore the two must be regarded as representing different falls. On the other hand, the similarity in structure between the Saltillo, the Allen County, Kentucky, the Chattooga, and Maverick County, Georgia, meteors, is so striking as to lead to the conclusion[19] that they must be parts of a single large body. In the last paper published by Huntington, the author declares that a single piece of the Coahuila iron presents the Widmanstättian or Neumann markings, or is amorphous, according to the portion of the mass from which the etched specimen is taken, and that, therefore, these markings cannot be depended upon as a means of classifying such meteorites. It is further shown that these markings, which have hitherto been regarded as characteristic of meteors, are present also on

[15] *Zeits. f. Kryst*, XV., p. 40.

[16] Crosby: *Technology Quarterly*, Feb. 1889, p. 248.

[17] Proc. Amer. Acad., 1886, XXI., p. 478.

[18] Ib., 1888, XXIV., p. 30.

[19] Ib., XXIV., p. 313.

etched surfaces of spiegeleisen.——Meunier[20] calls attention to the fact that we know almost nothing in regard to the nature of that constituent of certain meteorites which turns black upon being subjected to heat. He has been investigating the subject for many years, and now reports a few facts discovered by him with reference to the properties of the substance.——A meteoric iron found about the year 1880, on the top of the Alleghany Mountains, in Greenbriar County, West Virginia, weighs eleven pounds, has a specific gravity of 7.869, and contains cavities in which are masses of graphite. Upon treating a portion with hydrochloric acid, Fletcher[21] found fragments of chromite crystals in the insoluble residue. The composition is:

Fe	Ni	Co	Cu	P	S	Residue
91.59	7.11	.60	tr	.08	tr	.12

——The same author[22] gives an analysis of the Nejed iron, that fell in Central Arabia, in 1863. His figures are:

Fe	Ni	Co	Cu	P	S	Insol.	Sp. Gr.
91.04	7.40	.66	tr	.10	tr	.59	7.863.

——The tenth meteoric iron whose fall is authenticated by eye witnesses, has been described by Mr. G. F. Kunz.[23] It fell at Lamar, Johnson County, Arkansas, at 3.17 P. M., March 27th, 1886. The mass is in general flat and irregular in shape. It measures 17½ in. by 15½ in., and weighs 107½ pounds. Its analyses yielded: Fe= 91.87, Ni = 6.60, Co = tr, P = .41 C, S, etc., = .54.——A meteoric iron from La Bella Roca, a peak of the Sierra de San Francisco, Durango, Mexico, has been described by Whitfield[24] as containing little nodules of troilite. Those on the surface have been removed by weathering, leaving pits corresponding in size to the original nodules. ——In a very exhaustive chemical article upon the meteoric iron of S. Julião de Moreira, Portugal, E. Cohen[25] has given some valuable analyses of this meteor, as well as of its constituents. He gives also new analyses of the Scottsville, Allen County, Kentucky, iron, and of that of Fort Duncan, Maverick County, Texas.——A brecciated meteorite from the San Emigdio Mountains, California, is described by

[20] Bull. Soc. Franc. d. Min., 1889, XII., p. 76.

[21] *Min. Mag.*, Dec., 1887, p. 183.

[22] Ib., p. 187.

[23] Pro. U. S. Nat. Mus., X., p. 598.

[24] *Amer. Jour. Sci.*, June, 1889, p. 439.

[25] *Neues. Jahrb. f. Min.*, etc., 1889, I., p. 215.

Mr. Merrill[26] as consisting of olivine, iron, pyrrhotite, and minute fragments of a colorless, polysynthetically twinned mineral, probably of the pyroxene group, in an almost irresolvable fragmental ground mass. ——The Fayette County, Texas, meteorite[27] is interesting, because of the existence of a vein in it similar to the vein in the Ställdalen meteor described by Reusch.[28] The stone belongs to the chondrite group of Rose, with chondri composed of olivine or enstatite alone, or of both together. The vein consists of a black amorphous substance with a bronzy lustre, in which are scattered little blebs of iron and pyrrhotite, and a few colorless silicates. The composition of the mass of the stone is:

SiO_2	Fe	FeO	Al_2O_3	CaO	MnO	MgO	Ni.Co	S
37.70	4.41	23.82	2.17	2.20	.45	25.94	1.75	1.30

——To the large number of meteors already mentioned by many writers as having fallen in Chili, Sandberger[29] adds another. It consists of olivine, diopside, a little chromite and troilite as a fine-grained aggregate in which little flecks of metallic iron are imbedded. In this meteor were also found hydrocarbons and small grains of black carbon with a hardness over 9. These occur in the iron, and are, without doubt, forms of black diamond, similar to the substance lately found by Koksharow[30] in a Russian meteorite.——Mr. Eakins[31] gives the result of the analysis of a meteor obtained by Prof. Hill, of Texas. The stone is composed of olivine, enstatite, and probably a feldspar, besides five per cent. of troilite and a little chromite. Its specific gravity is 3.543, and composition:

SiO_2	Al_2O_3	Cr_2O_3	FeO	Fe	NiO	Ni	CaO	MgO	K_2O	Na_2O	S	Aq
44.75	2.72	.52	16.04	1.83	.52	.22	2.23	27.93	.13	1.13	1.83	.84

——Two new masses of meteoric iron have recently been described by Mr. Kunz.[32] The first weighs 428 grams. It was found on Linnville Mt., Burke Co., N. C. The second weighs 25.61 lbs., and was found in Laramie Co., Wyoming. Analyses of the two are as follows:

	Fe	Ni	Co	S	P	C
Linnville,	84.56	14.95	.33	.12	tr	tr
Laramie Co.,	91.57	8.31	tr		.07	tr

[26] Proc. U. S. Nat. Mus., 1888, p. 161. Cp. *Amer. Jour. Sci.*, 1888, p. 190.
[27] Whitfield and Merrill: *Amer. Jour. Sci.*, Aug., 1888, p. 113.
[28] *Neues. Jahrb. f. Min.*, etc., 1886, B. B. IV., p. 491.
[29] *Neues Jahrb. f. Min., etc.*, 1889, II., p. 173.
[30] *Mater. zur Min. Russl.*, X., p. 82.
[31] *Amer. Jour. Sci.*, 1889, p. 59.
[32] *Amer. Jour. Sci.*, Oct., 1888, p. 275.

BOTANY.

The Fresh-water Algæ of the Plains.— North-west of Thedford, Thomas Co., Nebraska, in the valley of the Middle Loup river, are quite a number of small stagnant ponds. They are chiefly portions of the river, cut off by the railroad which runs up the valley, or excavations along the track filled by rain drainage. On the 7th of August, 1889, I stopped here a day for the purpose of collecting algæ. The "Sand Hill region" of Nebraska is not one to which one would naturally turn for collecting algæ, but the list given below, which is the result of our day's work, shows it to contain an interesting algæ flora.

The ponds are shallow (2 to 8 in. deep), and have usually a firm, solid bottom, so that one may easily wade around in searching for specimens. The water is slightly alkaline. The edges of the ponds are usually lined with rank growths of various sedges and grasses, with, frequently, patches of the common arrow-head (*Sagittaria variabilis*, Engelm). One pond was noticeably lined by a thrifty growth of the rare grass *Catabrosa aquatica* (L.) Beauv. It extended into the pond for some distance, to where the water was nearly a foot deep. Quantities of *Potemogeton* and *Zanichellia palustris* L. grow from the bottoms of the ponds, and are frequently mixed with several species of *Chara*. In some of the ponds I collected also the beautiful Bladderwort, *Utricularia vulgaris* L. Its clusters of bright yellow flowers, here and there extending above the surface of the water, had a pleasing effect. At the edge of one pond I discovered also the little Bladderwort, *Utricularia minor* L. I notice that this commonly extends out a foot or so from the water, on the damp or wet bank, around the roots of sedges, etc. The three Duckweeds, *Lemna minor* L., *Lemna trisulca* L., and *Spirodela polyrrhiza* (L.) Schleid., are common in almost every pond. The liverwort, *Riccia fluitans* L. also occurs commonly.

The species of Algæ proper collected were as follows:—

CHROOCOCCACEÆ.

Merismopedia glauca Naeg. Not apparently very common here. In the eastern part of the State I have found it frequently.

Merismopedia violacea (Breb.) Kutz. Quite common, forming violet or purplish slimy masses, which sometimes reach the size of a

man's hand. It much resembles in appearance floating particles of decaying flesh, in this respect being similar to *Chlamydococcus pluvialis* A. Br., from which it is with difficulty distinguished without the aid of a microscope. (The latter I collected in quantity in a pond in Wessington Hills, Dakota, last April. The color is a somewhat deeper violet purple.) This interesting little plant has not been found before in America, so far as known. It is distinguished from known American species by its smaller size and violet color. Rev. Francis Wolle has examined specimens of it and confirmed my identification. I have to thank him also for much aid in my study of Algæ.

Chroococcus cohærens Næg. A beautiful blue-green species. Common.

NOSTOCACEÆ.

Oscillaria. Several species were observed.

Nostoc pruniforme Ag. Very common, forming olive or dark brown, nearly regular balls, from one millimeter diameter to the size of a plum. Floating in every pond.

PALMELLACEÆ.

Scenedesmus caudatus Corda. Var. *typicus* Kirch. Usually of two or four cells.

Scenedesmus dimorphus Kg. Not common.

Scenedesmus obtusus Meyen. Very common, presenting a number of forms.

Pediastrum angulosum (Ehr.) Menegh. Common. Cells about 16 μ in diameter.

Pediastrum borganum (Turpin.) Menegh. Common in several stages of development. Empty colonies occur frequently, the zoogonidia having escaped from all the cells.

Raphidium polymorphum Fres. One specimen was observed in the examination of the material, belonging probably to the variety *sigmoideum* Rab.

Polyedrium trigonum Næg., var. *punctatum* Kirch. Several specimens that I take to be this variety were found.

Protococcus viridis Ag. A deep green aquatic variety is quite common.

Euglena viridis (Schrank.) Ehrenb.

DESMIDIACEÆ.

We are usually told that desmids are to be sought in fresh, pure water only. My experience in Nebraska has not confirmed this statement. I have frequently searched running waters and springs for

them, but have seldom been rewarded, while I have found them almost exclusively in what I should term stagnant water.

Docidium baculum (Breb.) D. By. Not common.

Cosmarium bioculatum Breb. Not uncommon.

Cosmarium conspersum Ralfs. Not common.

Cosmarium meneghinii Breb. Not common.

Cosmarium nitidum De Not. Not common.

Cosmarium pulcherrimum Nord. Not common.

Cosmarium undulatum Corda. The only specimen found was partially undeveloped, but appears to be this species.

Euastrum verrucosum (Ehrb.) Ralfs. A common form.

Staurastrum gracile Ralfs. Not uncommon.

Staurastrum polymorphum Breb. Not common.

DIATOMACEÆ.

Diatoms are, as in most places, common objects. Species of *Epithemia* predominate.

Cymbella gastroides Kutz. A large form, usually about 130 μ long.

Navicula iridis Ehr., var. *amphigomphus* Ehr.

Navicula major Kutz. Common.

Navicula producta W. Sm. Not common. About 42 μ long.

Pleurosigma intermedium W. Sm. Rare.

Gomphonema clavatum Ehr. Rare. Length about 32 μ.

Gomphonema constrictum Ehrb. Common. Length 32–64 μ.

Cocconeis pediculus Ehr. Common. Elliptical, 13–19 by 18–22 μ.

Epithemia gibba Kutz. Not so common as the next. About 138 μ long.

Epithemia turgida (Ehr.) Kutz. Very common. From 46–91 μ long, usually about 16 μ wide. A very beautiful form.

Synedra ulna (Nitsch) Ehr. Common. A very long variety of this was also found.

Fragilaria harrisonii (W. Sm.) Grun. Only one frustule found. Size 14 by 22 μ.

Melosira varians Ag. Quite common. Forming in filaments from 15–16 μ wide.

Quite a number of other species were observed, of the genera *Nitzschia*, *Ceratoneis*, etc., but their identification remains doubtful.

ZYGNEMACEÆ.

Zygnema cruciatum Ag. Common in some of the ponds.

No attempt was made to collect the larger Algæ. Great masses of what I took to be Spirogyra floated in some of the ponds. Cushions of Vaucheria were common on the wet banks.—H. J. WEBBER, *Botanical Laboratory, University of Nebraska.*

ZOOLOGY.

Animal Coloring Matter.—C. A. McMunn (*Jour. Marine Biol. Assn. United Kingdom*, No. 1,) discusses briefly the coloring matters of several invertebrates. Among the interesting facts are these Spectroscopic examination fails to show the presence of symbiotic algæ in *Antedon*, it being found that contrary results were due to the presence of plants in the food, and that when the stomach was removed neither chlorophyll nor chlorofucin occurred in the extract. The digestive glands of echinoderms and crustacea not only form digestive ferments but exercise a chromatogenic function. Chlorophyll was found in several annelids, while other green worms possessed no chlorophyll. The lipochromes in some cases may act as an absorber of light rays, but its other function is very uncertain. The author shows that a knowledge of invertebrate coloring matter is absolutely essential to a clear understanding of the physiological action of the pigments of the Vertebrata.

The Polynoina.—H. Trautzsch discusses (*Jena. Zeitsch.*, XXIV., p. 61) the Polynoid worms of Spitzbergen. Eleven species are enumerated, of which one (*Harmothaë vittata*) is new. The generic limits are discussed, the genera of Malmgren, Levinsen, Kallenbach being considered. In the second part of the paper the morphology and physiology of the Nephridia are reviewed. The conclusions are as follows: In their simplest form the Nephridia are open saccular organs of the usual polychæte type, perforating the dissepiment, and opening exteriorly at the apex of a murally placed papilla on the hinder margin of the segment. Each nephridium is composed of funnel, inner loop, nephridial sac, outer loop and papilla; there being but a pair of nephridia in a segment, and each having but a single external opening. Nephridia are present in all segments, showing differences in each, and also between right and left. In the young animal all the Nephridia are essentially the same, but before and during the sexual maturity all except the first four pairs become more complex. All of the Nephridia are excretory organs, and the first four have no other function, and become genital ducts at the time of sexual maturity, the sexual products being forced to the exterior through the contractions of the surrounding muscles.

Reproduction of Fishes.—Mr. J. T. Cunningham gives (*Jour. Marine Biol. Assn. of the United Kingdom*, No. 1) the results of his studies of the ova, times of spawning, etc., of a number of British fishes. The paper will prove of considerable value to American students in the identification of the eggs and embryos of fishes. In the case of the mackerel, Mr. Cunningham found that no circulating apparatus served to keep the eggs, the density of the water possibly having considerable to do with the fatality. The mantle of cells which surround the oil globule at a later stage of the egg is regarded as formed of "periblastic syncytium." The egg regarded by Agassiz and Whitman as belonging to the smelt (*Osmerus mordax*) is said to belong to one of the Clupeoids. The fact is noted that fishes with much fat are apt to have oil globules in the eggs, while allied species with dry flesh have no oil globules. Some notes are given on the cœlom and vascular system. Six plates illustrate the paper.

The Halosauroid Fishes Typical of a Special Order.—Among the numerous representatives of the deep sea, or bassalian, fauna, one of the most characteristic is the family of Halosaurids. This family has been approximated by most ichthyologists to the Notopterids and Alepocephalids and their supposed allies. The external characters are however so peculiar, as manifested in the opercular apparatus and suborbital chain, that in 1883 I was convinced that the family represented a very distinct subordinal or ordinal group. Dr. Günther, in 1868 (Cat Fishes, B. M., vii., 482), assigned to the genus Halosaurus, a preoperculum produced behind into a long, flat process, replacing the sub- and interoperculum. The improbability of such a coalescence of the preoperculum and suboperculum, in view of our knowledge of the genesis and development of those bones, was so extreme that I availed myself of the first opportunity to examine the facts in the case. At Wood's Holl, in 1883, I uncovered the bones sufficiently to detect the true preoperculum, and to recognize that the supposed "preoperculum" of Günther was the exact homologue of the suboperculum. I deferred publication of any conclusions as to the affinities of the genus, however, till I could examine the skeleton. Meanwhile, a notice and illustrations of the skull and scapular arch of the genus have been published by Dr. Günther (Challenger Deep-Sea Fishes, pp. 232-236, Pl. 60, Figs. 1–8.) Dr. Günther at last recognized the true homologues of the opercular apparatus, but has not appreciated the systematic import of the facts disclosed. The peculiarities revealed by the skeleton are however numerous and important. Averse as I am to the multiplication of ordinal groups, it seems to me that in a system

of fishes based on morphological facts, the salient differences between the Halosaurids and other fishes must be expressed by an ordinal, or at least a subordinal, designation. I do not see how the group can be referred to any of the existing orders with the characters we now assign to them, and for the present, at least, propose to isolate it as a peculiar order characterized by the following features contrasted with those of the generally recognized orders:

LYOPOMI.

Teleosts with the scapular arch constituted by the proscapula, postero-temporal and post-temporal, the post-temporal discrete from the side of the cranium, and impinging on the supra-occipital; the hypercoracoid and hypocoracoid lamellar, and the fenestra or foramen in the upper margin of the hypocoracoid; the mesocoracoid absent; the actinosts normal; the cranium with the condyle confined to the basi-occipital; the opercular apparatus characteristic; the preoperculum being entirely detached from the suspensorium rudimentary, and connected only with the lower jaw; the operculum normally connected; the suboperculum enlarged and partly usurping the usual position of the preoperculum, in company with the suborbital chain, which is extended backwards toward the opercular margin; jaw bones complete and normal; palatines, entopterygoid, and ectopterygoid normally developed; the anterior vertebræ separate, and the ventrals abdominal.—THEO. GILL.

The Notocanthid Fishes as Representatives of a Peculiar Order.—The genus *Notocanthus* has long been shifted from place to place without finding a natural resting-place. It was indeed long ago suggested by Dr. Günther that "these fishes will, no doubt, have to be placed in a distinct order;" but he has neglected to do so, or to give any reasons why he thought so. The facts now known, however, warrant the isolation suggested, and the order may be defined by the following characteristics:

HETEROMI.

Teleosts with the scapular arch formed by the proscapula and post-temporal (or posterotemporal), the latter detached from the sides of the cranium, and impinging on the supraoccipital; the hypercoracoid and hypocoracoid coalesced into a single lamellar imperforate plate; the actinosts normal; the cranium with the condyle confined to the basioccipital (ill defined); the exoccipitals coalesced with the epiotics and opisthotics; the vomer obsolete; the opercular apparatus com-

plete, but the preoperculum slightly connected with or discrete from the suspensorium ; the suborbitals suppressed ; the jaw bones complete and little aberrant ; the palatines, entopterygoids, and ectopterygoids well developed ; the anterior vertebræ separate, and the ventrals abdominal.—THEO. GILL.

Note on Carettochelys, Ramsay.—Of this very remarkable Chelonian, which was found in Fly River, New Guinea, only a single specimen is known. It was described by Ramsay, in 1886, in the Proc. Linn. Soc., New South Wales, and compared with Emyda, with the remark that it appeared to be a link between the river, and the sea-turtles. Mr. Boulenger has placed it among the Pleurodira, in a new family, Carettochelydidæ.

The question is, Is it really a Pleurodiran? It is true it belongs to the Papuasian region, in which, so far, only Pleurodira have been found. There are some characters, however, not seen in the Pleurodira, but in another group of Chelonians consisting of the families Cinosternidæ, Staurotypidæ, and Pseudotrionychidæ. It is only in this group that we find 21 peripheralia (marginal bones) as in Carettochelys ; the neural bones are also reduced, and the dermal shields have disappeared entirely in Pseudotrionx ; to the latter character, however, I attach little value, as it may occur in any family.

It seems to me that the systematic position of Carettochelys is far from being clear. How easily could the whole question be settled! Mr. Ramsay would do a great service to science if he would undertake to have the cervicals and the skull extracted, or the cervicals alone, if he fears for the skull. This could be done without injuring the specimen, and the structure of these parts would show at once the affinities of this peculiar genus.

It is a pity that in some museums of natural history the anatomical knife is still an instrument without use. Rare or unique specimens are not allowed "to show the inside," or, in other words, to show what they really are. They are simply placed in alcohol or stuffed, to be presented to a public which has no understanding of them. There are exceptions, I am glad to say. One of these is seen in *Chlamydosclache*, of a single specimen which came to the Museum of Comparative Zoölogy, Cambridge, Mass., and was "sacrificed" to the anatomical knife. The result is known to every zoölogist.—G. BAUR.

Teeth of Monotremes.—Mr. Oldfield Thomas, (*Proc. Roy. Socy.*, No. 280) has had an opportunity to study the teeth of Ornithorhynchus, and comes to conclusions which essentially modify those of Poul-

ton. He finds that the true teeth are functional for a considerable part of the animal's existence, cutting the gum as usual, and, after being worn down by friction with food and sand, are shed from the mouth as are the milk teeth of other animals. The later cornules, or horny teeth, are certainly developed from the epithelium of the mouth cavity; but from that *under* and *around* instead of over the teeth, and the hollows in the horny plates are the vestiges of the original alveoli of the teeth, from out of which the latter have been shed. A result of this discovery is that we now have perfect calcified teeth large enough to be studied with the naked eye, and hence available for comparison with other forms. Mr. Thomas, aided by Lydekker and Boulenger, fails to find any teeth of recent or fossil reptiles or mammals which quite correspond to those of Ornithorhynchus. He is more and more inclined to believe in the correctness of the view of Prof. E. D. Cope, that the Multituberculata were monotremes, although the resemblances between the teeth are of the most general character.—J. S. K.

Zoological News.—Sponges.—The third and fourth part of the 48th volume of the *Zeitschrift für wissenschaftliche Zoologie* is devoted entirely to sponges. Conrad Keller devotes 95 pages and six plates to the sponge fauna of the Red Sea, and R. von Lendenfeld 296 pages and 15 plates to the physiology of these forms. His experiments consisted in feeding these forms carmine, starch, and milk, and in trying the effects of various poisons upon them. Among the conclusions are the following: The collar-cells absorb all that comes to them, holding the good and rejecting the useless. The canal system is physiologically comparable to that of polyps and medusæ, while physiologically the sponges are the closest of all animals to the plants.

Worms.—Arthur E. Shipley describes (Proc. Roy. Soc., No. 280) the structure of the Bahaman Gephyrean, *Phymosoma varians*. The points elucidated are the existence of skeletal structures at the anterior end of the body serving to support the tentacles and giving insertion to the retractor muscles; the alimentary canal; vascular system; nephridia, nervous system, sense organs, and reproductive organs. He thinks the points found confirm the arrangement of Phoronis near the Gephyrea in Ermis.

Vertebrates.—J. Beard has a preliminary notice of the early development of *Lepidosteus osseus* in the Proceedings of the Royal Society, No. 280. He obtained his material in northern New York. Among the points obtained are these: There is no neurenteric canal.

In the deevlopment of the nervous system there are formed transitory giant ganglion cells which are shut out of the central nervous system and persist for a long time lying outside the cord. They apparently form a transitory larval nervous system, possibly analogous to the subumbrellar cells described by Kleinenberg as ushering in the permanent ventral cord in Lopadorhynchus.

In the *Verhandlung* of the third meeting of the German Anatomical Soclety, Karl Bardeleben presented evidence for the existence of a sixth normal toe in the Mammalia. He finds in the skeletons of several forms bones on the radial side of the hand which he regards as evidence of a finger outside of the thumb, to which he gives the name prepollex; the corresponding structure in the foot is the prehallux. The existence of these additional digits has been seriously questioned, the bones being regarded as sesamoid. In *Pedetes capensis*, however, Bardeleben finds a true sixth finger which is furnished with a nail, and which seems to represent a thumb in function. Tornier, at the meeting, regarded these sixth fingers and toes in the Mammalia as physiologically new structures, not as ancestral features.

EMBRYOLOGY.

Evolution of the Medullary Canal.—Under this head we have to consider, first, what is the primitive vertebrate type of the central nervous system; second, what genetic relation existed between the vertebrate and invertebrate types.

The opinion generally accepted by embryologists is that the typical vertebrate canal is formed by the closure of the medullary groove. This view is advocated by Balfour, and has been so thoroughly accepted by Adam Sedgwick that he has made it the basis of a speculation[1] on the original function of the canal; he supposes that it was open behind and excretory; the cilia which are found in the central canal of the spinal cord originally served to produce the excretory current. This opinion overlooks the serious difficulty of assuming that the canal is primitive, while in the lowest vertebrates it is clearly a secondary modification. In Petromyzon, Lepidosteus and Teleosts, the medullary plate, instead of becoming the floor of an external groove, forms a solid keel-like projection towards the ventral

[1] A. Sedgwick. On the Original Function of the Canal of the Central Nervous System of Vertebrata. Proc. Philos. Soc. Cambridge, Eng. IV., 325-328.

surface. This keel subsequently becomes separated from the superficial layers of the ectoderm, and afterwards a central canal is developed in it. In the ganoids, which approach the elasmobranchs in structures there is, as shown by Selensky[2] a medullary groove of peculiar form, which suggests a transition from the solid keel to the open groove; again in amphibia there is evidence that the delamination is still preserved to a slight extent in that group. These considerations lead me to the hypothesis that the nervous system of vertebrates was primitively a solid axial thickening of the ectoderm, and within the class of ganoids became modified into a groove, perhaps simply by more precocious development of the central canal; the groove type has been kept in elasmobranchs, amphibians and amniota. Balfour (Comp. Embryol., II., 303) thus defends the opposite view: "It seem, almost certain that the formation of the central nervous system from a solid keel-like thickening of the epidermis is a derived and secondary mode; and that the folding of the medullary plate into a canal is primitive. Apart from its greater frequency, the latter mode of formation of the central nervous system is shown to be the primitive type by the fact that it offers a simple explanation of the presence of the central canal of the nervous system; while the existence of such a canal cannot easily be explained on the assumption that the central nervous system was originally developed as a keel-like thickening of the epiblast."

It is not possible at present to decide positively between the two views, but the view which I am inclined to adopt is further justified by the development of the central nervous system in annelids, which is formed by the coalescence of a pair of linear cords: these cords arise each side of a cilated longitudinal furrow, first as a single row of ectodermal cells, subsequently as several rows; while still united to the external ectoderm they extend towards one another below the ciliated cells of the furrow, and unite in a single nervous band. In leeches and arthropods the development is very similar. In all these cases the bands split off from the ectoderm. It appears, then, that in the nearest[3] invertebrate allies of the vertebrates the nervous system develops as a thickening along the inner surface of the ectoderm, and delaminates from that layer. It seems to me very natural to suppose, therefore, that the strikingly similar process in the lowest vertebrates is the primitive one, and that the canalization of the medullary plate was evolved within the vertebrate series.

[2] W. Salensky. Recherches sur le développement du sterlet (*Accipenser ruthenus*). *Arch. de Biol.*, II., 233–341. Taf. XV.–XVIII.

[3] With, of course, the possible exception of Amphioxus.

I have assumed that the ventral nerve cords of annelids are homologous with the medullary canal, a view that is now generally accepted by embryologists. Balfour (Works I., 393, and Comp. Embryol., II., 311) has suggested a more complicated relation in his hypothesis that the lateral nerve trunks which are known in many of the lower worms (*e. g.*, nemerteans) have fused on the ventral side, in annelids on the dorsal side, of the body in the vermean ancestors of vertebrates. In favor of this ingenious surmise no evidence has since been found. Hubrecht denies the homology of the annelidan nerve chain and the vertebrate medulla; he considers[4] that the more primitive condition is represented by certain nemertean worms, which, besides two main lateral nerves, have a small longitudinal median nerve; the lateral nerves gave rise to the nerve chain of annelids by their fusion, the median nerve to the medulla of the ancestors of vertebrates. As no intermediate forms, either adult types or embryonic stages, are known to represent any phase of this double metamorphosis, I cannot admit that Hubrecht's bold speculation invalidates what seems to me the well established homology between annelids and vertebrates.—CHARLES SEDGEWICK MINOT.

ARCHÆOLOGY AND ETHNOLOGY.

The Recent Accessions to the Museum of the Peabody Academy of Science of Salem, Mass.—The accessions to the Museum of the Peabody Academy of Science, in East India Marine Hall, have, from time to time, been noticed in these columns. In no single year since the formation of this institution have these accessions been so numerous or of so valuable a character. Prof. Edward S. Morse, as is well known, was absent for several months in Japan and the east, for the purposes of study and forming collections, one of his chief objects being to obtain for our museum a characteristic and complete collection to illustrate the ethnology of Japan.

The museum previously contained but few specimens from this country, although some of these few were very valuable, while China, India, Africa, and the South Sea Islands, were fully represented. Our mercantile relations with Japan were insignificant during the time of Salem's commercial period, the time when the East India collection was formed, and indeed it is only since the opening of that country to

[4] A. A. W. Hubrecht. The Relation of the Nemertea to the Vertebrata. *Quart. Jour. Micros. Sci., N. S.*, XXVII., 605–644, Pl. XLII.

commerce, after 1854, that it has been made possible to obtain specimens in any considerable numbers. And now a serious danger arises. The sudden influx of foreigners into Japan, and the demands of trade, have changed the character of manufactures, and the customs of the people brought in contact with the foreigners, rendering it more difficult year by year to obtain genuine Japanese articles uncontaminated by foreign influences. The quality of the majority of the exported lacquered ware has vastly deteriorated, the exported porcelain has succumbed to the demands of foreign taste; the screens, fans, lanterns, cloths, and papers which come to us cease to fairly illustrate the best art and forms, and mislead rather than instruct us as to the exquisite tastes of these interesting and refined people.

It is therefore peculiarly fortunate that in Salem, Mass., where already exists one of the finest ethnological collections in the world, there should be added, from Japan, so complete a collection as that recently placed on exhibition. Formed by one having exceptional relations with the Japanese in their inside life, both as friend and instructor, it has been made possible to gather a cabinet at once pure as regards the art and customs of the people, and complete in illustrating all the branches properly included in ethnology.

The catalogue of Japanese accessions enumerates 691 specimens. These have been arranged, temporarily, in one of the new long cases on the eastern side of the hall, and occupy some fifty feet of glass front. The most conspicuous objects are the life-sized figures: a warrior in full armor as used before the late revolution and the introduction of European methods and arms; the gentleman and wife with their two children, a boy and a girl; and the farmer and wife, the latter bearing an infant characteristically tied upon her back. These models were all made for the museum, and are the best ever brought to this country. Looking at them, the visitor is at once struck by what we should term the undersize of the Japanese, and we can readily see how a man of our ordinary height can overlook a Japanese crowd without difficulty, as is often stated to be done.

One section contains a collection of swords and blades, 37 in number, many of great beauty and all of fine workmanship, together with numerous knives and sword guards, the latter objects being greatly valued in Japan for their exquisite finish and design, often bringing large prices at special sales. All of these were presented to the museum by Mr. Machida, a noted sword merchant of Tokio, who says in his letter to Mr. Morse, "I present the swords and implements of war formerly used in Japan, to the museum, thinking that they may do

some good for the purposes of scientific inquiries." Many of these swords and knives are 100 years old, and some are from 200 to 300 years.

The Tokio Educational Museum, in exchange for a collection of corals forwarded by the Academy last year, contributed 13 sets of tools (164 specimens), together with pictures illustrating the different trades and professions. They include among others those of the carpenter, cooper, mason, jeweler, turner, lacquerer, lantern-maker, potter, ivory carver, and gardener. The fisherman's nets and lines and the insect collector's outfit are also included. The collection contains garments of coarse and those of finer quality, shoes, hats, hair ornaments and combs, models of the kitchen, tea room, reception room, and shrine; of a fire engine, which by the way is carried about by two men in the manner of a hand barrow, of vessels and firemen's badges. Articles of domestic use include tea cups and sake cups, trays, bowls, baskets, bottles, tea-pots, spoons, moulds, barber's case, smoking apparatus, brushes, dishes, etc. Amusements are illustrated by games, cards, toys, dolls and kites, and these are followed by musical instruments of various sorts, such as harps, guitars, flutes and drums.

It is useless to go into farther details, as the collection is now on public exhibition, and may be seen by all who able to visit the museum. Many of the specimens were given by Japanese friends of Mr. Morse, including even servants, who seemed to fully understand the purpose in forming the collection, and the value of even the commonest object so long as it illustrated the people and their ways. Among other donors the name of Dr. W. S. Bigelow should not be omitted, as the catalogue amply testifies.

In addition to the collection from Japan, a temporary arrangement has also been made, in a case on the western side of the hall, of the objects collected in China, Anam, and Singapore, and those obtained from Korea, Yesso, and Manila. Altogether these collections occupy some thirty feet of case room, and include many rare and interesting articles. There are models of boats from China, and implements, clothing, and articles of domestic use from all of the above countries. The objects from Korea and those from Yesso, it should be remembered, small in number though they may appear, form a larger representation from these countries than has heretofore been obtained by any museum in this vicinity, and besides, many of the articles are of great rarity. One entire section of this case contains a special collection of Chinese implements, ornaments, and utensils, from William Dolan, Esq., of Hong Kong.

The rapid increase of the collections in the museum indicates that at no distant day farther space will be required to exhibit properly even such specimens as can in no way be placed in study collections to be kept in storage cabinets. It would be far better of course to have a special room for the natural history collections, leaving to East India Marine Hall the ethnological collections, so full of interest, and which form, together with the fine building that contains them, a most fitting monument of Salem's commercial period. In this hall, and forming part of this collection, is the proper place for many articles which even now may be found in the houses, in the attics and sheds perhaps, of this neighborhood. These articles are of themselves of little value, and of no use where they are, but placed in the museum they would each contribute their share towards making the finest American ethnological cabinet, and serve to interest and instruct generations of Salemites to come. Our citizens ought to think of this and see that all such objects are added to the museum, an institution we cannot feel too proud to own, and one that is prepared more fully than ever to care for and properly preserve these relics in the future as it has done for eighty years in the past.—*The Salem Register.*

ENTOMOLOGY.

Preliminary Catalogue of and Notes on Nebraska Butterflies.—This list includes species of *Lepidoptera Rhopalocera*, or, properly speaking, diurnal butterflies. It includes only specimens collected by the writer and in the State Normal School collection, excepting where it is otherwise stated. Some few species have been omitted in order to await further study.

The names of localities where we have made collections is given by counties, those mentioned as from Dodge county being made mostly by Mr. E. A. Dodge, of Glencoe. Mr. Dodge has collected in Nebraska during the last fifteen years, and perhaps has the largest and finest collection of butterflies within the State. His list and notes, so far as we are aware, have not been published.

The notes on the dates of appearance of different species were made largely during the spring of 1889,—a spring beginning somewhat earlier than usual,—and are given mostly for Peru, Nemaha county, on the Missouri River.

The specimens collected in the northern and the north-western portions of Nebraska were made during the months of July and August, 1889. The line of counties from which collections were made, it will be noticed, runs from south-east Nebraska, the lowest portion of the State, to north-west Nebraska, the part of the State having the greatest elevation.

FAMILY PAPILIONIDÆ.

1. *Papilio ajax.*—Ajax Butterfly. Adams, Dodge and Nemaha counties. Found from the first of April till the last of October, though at no time abundant. Several forms.

2. *P. philenor.*—Orange-banded Butterfly. Dodge and Nemaha. Somewhat rare. Earliest found about the first of June, though probably may be collected in May.

3. *P. asterias.*—Black Swallow-tail Butterfly. Dodge and Nemaha. Appears about the middle of May, but most plentiful the first of June, though at no time very common.

4. *P. palamedes.*—Olive-black Swallow-tail Butterfly. Dodge. Mr. E. A. Dodge mentions capturing one specimen. Not seen by us.

5. *P. turnus.*—Yellow Swallow-tail. Dodge and Nemaha. Found as early as April 15th, becoming very common the last of this month and the first of May. Rare in the fall, and but few males and some variations in markings of females.

6. *P. cresphontes.*—Yellow-banded Swallow-tail. Dodge and Nemaha. The first brood appear in abundance the last of May and first of June. Second brood common in August, becoming very rare by the last of September.

FAMILY PIERIDÆ.

7. *Pieris protodice*—Banded-white Butterfly. Dawes, Dodge, Lancaster, Nemaha and Sheridan. Found as early as the first of May, and continuing till late in the fall. According to Mr. C. G. McMillan, Nebraska species, as at other points, "commonly appear twice during the season, first in May and last in July or early in August." Somewhat common in eastern Nebraska, but more common in north-western Nebraska, where we have observed it, and in south-western part of the State where it was observed by Mr. McMillan.

8. *P. napi.*—White Butterfly. Lancaster and Nemaha. One specimen taken near Peru, May 16th, 1889, and Mr. McMillan mentions one specimen collected by him in Lancaster county.

9. *P. rapæ.*—Cabbage Butterfly. Dodge, Lancaster and Nemaha. Found as early as the first of April, and abundant by the middle of

this month, remaining till very late in the fall. Mr. McMillan, who has studied this insect in Nebraska, says, "*Rapæ*, however, is sometimes three-brooded,—a last brood appearing some time in September. In rare instances they pass the winter in the perfect state. I have upon two occasions caught males of this species in January, both times in a barn loft. They seemed dead, but upon being brought near the fire soon revived. I have also reared three broods artificially during the summer of 1885. Eggs were taken from the cabbage in May, and from these imagines were reared, appearing the middle of July, and from this second brood other imagines appeared in September. I have also seen fresh insects in September, indicating that this is natural in our climate."

10. *Nathalis iole.*—Saffron-yellow Butterfly. Dodge and Nemaha. Abundant and found rather late in the fall.

11.—*Anthocharis olympia.* Yellow-green-banded Butterfly. Dodge. Mentioned by Mr. E. A. Dodge and by Prof. French, but not observed by us.

12. *Callidryas eubule.*—Citron Butterfly. Dodge and Nemaha. Somewhat rare, but has been found as early as May and as late as September.

13. *C. agarithe.*—Orange Butterfly. Dodge. Mentioned by Mr. E. A. Dodge and by Prof. French as occasional in Nebraska. Not observed by us.

14. *Colias cæsonia.*—Dog's Head Butterfly. Adams, Dawes, Dodge, Nemaha and Sheridan. Does not appear till the last of May or first of June, but remains till late in October. Quite common.

15. *C. eurytheme.*—Bordered Yellow and Orange Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears as early as the first of May, becoming abundant by the middle of this month, remaining till some time in October. Several forms.

16. *C. philodice.*—Bordered Yellow Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears as early as the first and common by the middle of May; remains till some time in October.

17. *Terias nicippe.*—Black-bordered Orange Butterfly. Dodge. Mentioned by Mr. Dodge as uncommon. Not observed by us.

18. *T. mexicana.*—Mexican Butterfly. Dodge. Mentioned by Mr. Dodge as uncommon, and by Prof. French as "occasional in Nebraska." Not collected by us.

19. *T. lisa.*—Little Bordered Yellow Butterfly. Dodge and Nemaha. Somewhat common in certain localities.

FAMILY NYMPHALIDÆ.

20. *Danais archippus.*—Milk-weed Butterfly. Adams, Brown, Dawes, Dodge, Nemaha, Sheridan, and other counties. This well-known butterfly appears by the middle or sometimes the first of April, and remains till cold weather. It undoubtedly hibernates, although we have not found it in winter. At least three points favor this conclusion; firstly, its remaining so very late in the fall; secondly, its appearing very early in the spring; thirdly, the early species invariably have the appearance of old and worn specimens, being decidedly faded in color.

21. *D. berenice.*—Rufous-brown Milk-weed Butterfly. Dodge. Mr. Dodge mentions one specimen as collected by other parties. Not observed by us.

22. *Argynnis idalia.*—Regal Silver-spotted Butterfly. Dodge and Nemaha. Common by the first of July, remaining till the last of September.

23. *A. cybele.*—Yellow-banded Silver-wing. Adams, Dodge and Nemaha. Appears in abundance by the first of June, but disappears by early fall.

24. *A. aphrodite.*—Silver-winged Butterfly. Nemaha. Not very common.

25. *A. alcestis.*—Yellowish-fulvous Silver-winged Butterfly. Dodge and Nehama. Not very common.

26. *A. myrnia.*—Silver-bordered Butterfly. Dodge. Mentioned by Mr. Dodge, but not observed by us.

27. *A. bellona.*—Meadow Butterfly. Dodge. Mentioned by Mr. Dodge, but not observed by us.

28. *Euptoieta claudia.*—Pale-red Butterfly. Dawes, Dodge and Nemaha. Appears as early as the middle of May; somewhat common.

29. *Melitæa phaeton.*—Red-bordered Butterfly. Lancaster. Prof. French gives this species as "United States, east of the Rocky Mountains," but Mr. McMillan says, "I once found a pupa of *Melitæa phaeton*, not an indigenous species, attached to a N. Y. C. & H. R. R. freight car, standing on the B. & M. yards at Lincoln." Not observed by us.

30. *Phyciodes nycteis.*— Silver-crescent Butterfly. Dodge and Nemaha. Appears in small numbers about the first of June.

31. *P. carlota.*—Fulvous-spotted Silver-crescent Butterfly. Dawes and Dodge. Have not collected but few specimens.

32. *P. tharos.*—Little Black-bordered Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears about the last of April,

becomes abundant about the middle of May, and is found very late in the fall.

33. *Grapta interrogationis.* — Semicolon Butterfly. Dodge and Nemaha. Found in small numbers from very early Spring till late fall.

34. *G. comma.*—Comma Butterfly. Dodge and Nemaha. Found as early as the last of March and, remains till late fall.

35. *G. faunus.*—Green-banded Comma Butterfly. Nemaha. Found occasionally.

36. *G. progne.*—Gray-winged Comma. Nemaha. Rather common in late summer and fall.

37. *Vanessa antiopa.*—Yellow-bordered Butterfly. Dawes, Dodge and Nemaha. Appears by the latter part of March, or earlier, and remains till cold weather. Somewhat common in August and September.

38. *Pyrameis atalanta.*—Red Admiral. Dawes, Dodge, Nemaha and Sheridan. Appears first about the middle of April, and again appears the middle or last of May. Found the last of September and first of October.

39. *P. huntera.*—Hunter's Butterfly. Dawes, Dodge, Nemaha and Sheridan. Appears as early as the middle of May, becoming rather common a little later.

40. *P. cardui.*—Thistle Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears by the middle of April, abundant by the fifteenth of May, and common in late fall.

41. *Junonia cnœia.* — Buck-eye Butterfly. Dawes, Dodge and Nemaha. Appears the last of May or first of June, but at no time very common.

42. *Limenitis ursula.*—Blue-banded Butterfly. Dodge and Nemaha. Appears about the first of June; somewhat rare.

43. *L. arthemis.*—White-banded Butterfly. Nemaha. Found in May, but very rare.

44. *L. disippus.*—Banded-red Butterfly. Dodge and Nemaha. Appears as early as May 15th, and reappears in the fall, but never very common.

45. *Apatura celtis.*—Rusty-gray Butterfly. Dodge. Mentioned by Mr. Dodge, but not seen by us.

46. *Paphia troglodyta.*—Copper-red Butterfly. Nemaha. September 28th, 1889, we captured a specimen of this butterfly, the only one we have noticed in the State, owing probably to its near resemblance to the Grapta butterflies. It is given by Prof. French.

47. *Debis portlandia.*—Pearly Wood Butterfly. Nemaha. Only one specimen in our collection.

48. *Neonympha canthhus.*—Ten-spotted Quaker Butterfly. Dodge. Mentioned by Mr. Dodge, but not observed by us.

49. *N. eurytris.*—Six-spotted Quaker Butterfly. Dodge and Nemaha. Usually makes its appearance about the first of June.

50. *Satyrus alope.*—Common Wood Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Several varieties found, some of them quite common. Appears as early as the last of March, and becomes quite abundant by the middle or last of April. The middle of July, 1889, I found them very abundant at the base of Crow's Butte, Dawes county.

51. *Libythea bachmanii.*—Red and Black Beaked Butterfly. Dodge Not observed by us, but mentioned by Mr. E. A. Dodge.

FAMILY LYCÆNIDÆ.

52. *Thecla humuli.*—Gray-streaked Butterfly. Dodge. Not observed by us, but mentioned by Mr. Dodge.

53. *T. acadia.*—Pale-streaked Butterfly. Dodge. Mentioned by Mr. Dodge, but not collected by us.

54. *T. edwardsii.*—Edward's Streaked Butterfly. Dodge. Mentioned by Prof. French and by Mr. Dodge, but not collected by us.

55. *T. calanus.*—Banded-streaked Butterfly. Nemaha. Seems to be somewhat common about the first of June.

56. *T. pœas.*—Nemaha. One specimen collected October the first, 1889.

57. *T. niphon.*—Black and White Banded-streaked Butterfly. Nemaha. Appears about the first of June; very rare.

58. *T. titus.*—Coral-streaked Butterfly. Dodge. Mentioned by Mr. Dodge, but not observed by us.

59. *Chrysophanus dione.*—Dodge. Mentioned by Prof. French and Mr. Dodge, but not observed by us.

60. *C. thaë.* Large Copper Butterfly. Dodge and Nemaha. We have collected but one specimen.

61. *Lycæna pseudargiolus.*—Pale-blue Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears abundantly during the month of April, and was found in Dawes and Sheridan counties about the first of July. Forms numerous.

62. *L. comyntas.*—Tailed-blue Butterfly. Dodge and Nemaha. Commonly found, but not abundant.

FAMILY HESPERIIDÆ.

63. *Ancyloxypha numitor.*—Bordered Skipper. Dawes and Dodge. Observed in Dawes county in July.

64. *Pamphila massasoit.*—Yellow-cross Skipper. Dodge. Mentioned by Prof. French and by Mr. Dodge, but not observed by us.

65. *P. zabulon.*—Orange and Brown Skipper. Dodge. Not observed by us, but mentioned by Mr. Dodge.

66. *P. sassacus.*—Pale-spotted Skipper. Given as from Nebraska by Prof. French; not collected by us.

67. *P. uncas.*—Dodge. Mentioned by Mr. Dodge as rare or extinct

68. *P. leonardus.*— Leonard's Skipper. Dodge and Nemaha Seemingly rare.

69. *P. huron.*—Velvet-spotted Skipper. Dodge. Mentioned by Mr. Dodge, but not observed by us.

70. *P. phyleus.*—Dodge. Mentioned by Mr. Dodge; not in our collection.

71. *P. peckius.*—Peck's Skipper. Brown and Dodge. Somewhat rare.

72. *P. cernes.*—Clear-winged Skipper. Dodge. Not collected by us, but observed by Mr. Dodge.

73. *P. metacomet.*—Immaculate Skipper. Dodge and Nemaha. Seems to be rare.

74. *P. bimacula.* — Two-spotted Skipper. Dodge and Nemaha. A few specimens collected in May.

75. *P. pontiac.*—Green-margined Skipper. Dodge. Not collected by us, but mentioned both by Prof. French and Mr. Dodge.

76. *P. dion.*—Dodge. Mentioned by Prof. French, also by Mr. Dodge as rare or extinct; not observed by us.

77. *P. palatka.*—Given by Prof. French, but not observed by us.

78. *P. vitellus.*—Dodge. Not observed by us, but given by both Prof. French and Mr. Dodge.

79. *P. delaware.*—Yellow-winged Skipper. Dodge and Nemaha. A few specimens collected the last of May.

80. *P. hianna.*—Four-spotted Brown Skipper. Dodge and Nemaha. But very few specimens collected by us.

81. *Pyrgus tessellata.*—Brown, Dawes, Dodge, Nemaha and Sheridan. Appears the last of May and is quite common during late fall.

82. *Nisoniades juvenalis.*—Dodge. Not collected by us, but mentioned by Mr. Dodge.

83. *Pholisora catullus.*—White-dotted Black Skipper. Dodge and Nemaha. A few specimens collected the first of June.

84. *Eudamus tityrus.*—Silver-spotted Skipper. Dodge and Nemaha. Found rather abundantly from the first of May till the middle of June, perhaps later.—W. EDGAR TAYLOR, *Nebraska State Normal School, Peru, Neb.*

PSYCHOLOGY.

The Devices of Criminals in India.—The writer of a series of articles in the *Times of India* on "By-paths of Crime in India," mentions some devices of habitual criminals in that country. One curiosity which he was shown on a visit to the Presidency gaol in Calcutta was a heavy lead bullet about three-quarters of an inch in diameter. This was found on an habitual thief, and was being used to form a pouch or bag in the throat for secreting money, jewels, etc., in the event of his being searched. The ball is put into the mouth and is allowed to slide down gently until it reaches some part near the epiglottis, where it is held in position, and is kept there for about half an hour at a time. This operation is repeated many times daily, and gradually a sort of pocket is formed, the time being longer or shorter according to the size of pocket required. In some cases six months have been sufficient, in others a year, while in some cases two years are necessary. Such a pouch as this last is capable of holding ten rupees —about the size of ten florins. The thief therefore can undergo search, and, nothing being found, he goes away with the spoil in his throat, the power of breathing and speech being in no way interfered with. About a score of prisoners in the Calcutta gaol have such pouch formations. In the hospital of the prison the visitor learned some of the malingering practices of Indian criminals. In one case he saw a youth who was a perfect skeleton, with lustrous eyes looking out in a ghastly manner from a worn, haggard face. It was discovered that he had for two years been taking an irritant poison, with a view to produce diarrhœa, in order to shirk work and get pleasant quarters in the hospital. But he had overdone the part, for he had reduced himself to such a condition that recovery was all but impossible. This taking of internal irritants is a common practice amongst the habitual criminals of Calcutta. Castor oil seed, croton seed, and two other seeds, which have no English name, are the agents most commonly employed. One man was pointed out who, in order to get off his fetters, had produced an ulcer by rubbing the chafed skin with caustic lime, and then irritating the sore by scratching it with a piece of broken bottle. The segregation of lepers has long been the practice in Indian prisons, and it is mentioned as an example of the increase of leprosy in India that the disease occurs with much greater frequency amongst the criminals of Bengal than it did ten years ago.

The Home Instinct in Toads.—I originally introduced a few toads into the cellar of my house to destroy slugs, and in a few years they became more of a nuisance than the slugs had been. I had the tenants (my father-in-law and family) to send a lot of them, probably a hundred, over to my greenhouses, all of which were on a level with the ground. The toads came one-half in a tin slop bucket, and the other in a market basket,—both covered. The first day they were to be seen almost everywhere, but restless and excited. Next day very few were to be seen. On the third day none could be found, but on *that* day a large number were seen by several members of the family at the only opening into the cellar,—the cold air flue. None were seen again at the greenhouses (except a few that could not jump the three steps to the surface.) I firmly believe they found their way back, but of course cannot be positive. No toads, except perhaps a single one at a time, had ever before been seen in that yard, and their appearance there in such quantity, in a reasonable time after the disappearance at another place in similar quantity, to my mind is pretty clear. The bee-line distance is about a third of a mile, with two races and the creek between. We have proof of similar home instinct in the cat, carrier pigeon, four-week-old pig, land tortoise, and almost every bird; why not in the toad? I have had the same little owl return to my conductor spout for twenty-five years.—EDWARD TATNALL.

Wilmington, Delaware.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—New Brighton, April 11th, 1889.—Meeting called to order at 8.30 o'clock. Dr. N. L. Britton called attention to several specimens of silicified fossils found by Mr. Arthur Hollick in the white Cretaceous gravel on the side of a brook near Prince's Bay. They consisted of a brachiopod mollusk, allied to Pentamerus, a cyathophylloid coral, perhaps Zaphrentis, and a third one, probably a sponge. Dr. Britton remarked as follows: This is one of the most interesting discoveries recently made in our local geology, and is of much more than local importance, inasmuch as it affords valuable evidence towards establishing the origin of the formation known as the Yellow Gravel or Pre-glacial Drift, which has been frequently alluded to in our "Proceedings." I have been especially interested in this latter formation for several years, as it has been a much debated question whence came the yellow gravel, and

sand composing it, and from which it derives its name. There were difficulties in the way of accepting hypotheses, advanced by several eminent authorities, that it came either from the northwest or southeast. After a careful survey of a large part of the region where it is found in New Jersey, I had arrived at a conclusion, as long ago as 1883, that it had been derived from the erosion of Cretaceous strata containing gravel outcropping in the vicinity, and that after erosion it had been colored by ferruginous waters. [See Trans. N. Y. Acad. Sci., Vol. IV.] That this coloring is merely more or less on the surface may be seen by breaking the pebbles composing the gravel, and noting the white interior portions. The discovery of these fossils in the Cretaceous gravel goes far towards strengthening the conclusion, for it is a well known fact that similar fossils occur in the Pre-glacial Drift, and we have specimens in our cabinet from the Prince's Bay Bluff and Todt Hill, as previously reported to the Association. The beds of white gravel must lie near the base of the Cretaceous system, and form the exposures at Glen Cove, N. Y., and Camden, N. J. They are known to be of considerable thickness and extent, and as there is unmistakable evidence of some hundreds of feet of erosion from all this part of the country since the Cretaceous era, there is nothing extraordinary about the proposition. The problem still remains, however, Where did these silicified fossils come from originally? We have traced them back one step further, from the Pre-glacial Drift to the Cretaceous gravels, but that is as far as we can go at present. There are ledges of rock from which they might have been derived in Morris county, N. J., but the abundance of silicified fossils in the Pre-glacial Drift seem to require some less remote source.

Mr. Hollick described a recent visit to the Triassic outcrop at Mariners' Harbor, in company with Dr. Britton. This outcrop was mentioned by Wm. W. Mather in "The Geology of New York," where he says (see page 285): "In Richmond county, Staten Island, the red sandstone occupies but a small area where it can be observed * * * * it is believed to range from between Bergen Point and Shooter's Islnad, south-south-westwardly to the Freshkill marshes. It is generally covered by soil, drift deposits, and the sand and clay beds. It may be seen at very low tide, on the shore, about southwest of Bergen Point. It is the slaty, micaceous, fissile, red sandstone and shale." On page 294, in speaking of so-called bird tracks found in the same sandstone in Connecticut, he says: "I have seen no tracks on the red sandstone of Rockland and Richmond Counties, but they may very possibly be found there. My researches were necessarily very

limited, in examining this, and in fact all the regions explored in New York." The beach within the limits above described was carefully examined, and although the tide was high the existence of the outcrop was clearly demonstrated. Fully three-fourths of the shingle is composed of red sandstone and shale, and at a point immediately to the west of the foot of South Avenue there is a portion of the beach composed entirely of red clay and decomposed red shale, which is undoubtedly the outcrop described by Mather, although very much broken up by the action of the waves and weather. At this locality a large flat piece of red sandstone was found containing well-defined impressions of some vegetable remains, probably algæ. [The specimen was here presented.] There does not seem to be any other record in regard to this outcrop since Mather so briefly mentioned it, in 1843, and this specimen is probably the only Triassic fossil ever found in place on Staten Island. These facts should be recorded at the present time, as no doubt the shore is destined to be "improved" at no very distant date, and then the outcrop will suffer the same fate as that of the tremolite at New Brighton and the granite at Tompkinsville. There are indications that the Triassic strata are very near to the surface at other localities, especially where a new road is being cut through towards Erastina station. Along one portion of this road the soil is composed entirely of red clay and broken red shale, similar to that upon the shore.

Mr. Wm. T. Davis read the following letter:

NEW YORK, March 27th, 1889.

MR. WM. T. DAVIS.

DEAR SIR:—In reading over the proceedings of your society in the *Standard*, you (the proceedings) say there are no natural butternut trees on the Island. In the town of Westfield, along a stream known as Sandy Brook, there was a natural grove of them extending over nearly half a mile; many of them are there probably yet. This brook is the head-water of Lemon Creek, which runs into Prince's Bay. Part of the trees stood in a wood of my father's; the brook runs in a northerly direction from the Amboy road and crosses the Woodrow road. Yours,

A. WINANT.

Mr. Davis presented further notes upon the locality, and exhibited some butternuts from the trees referred to. Sandy Brook is quite appropriately named. Its course for about a half mile is through a loose sandy soil, and in some of the adjoining fields the yellow drift is sparingly represented, the sand being particularly free from stones of

any kind. The yellow gravel is a feature of the neighboring hills. The butternut trees grow in this sand near the brook, and at the present time about ten full grown and a few small ones are standing. A tree leaning over the brook, and to which fence rails have been nailed, measures, at about a yard from the ground, five feet one inch in circumference, and several of the others are nearly as large. They are well known to the people in the vicinity, and one old woman said she had gathered a half a bushel of the nuts last Fall. Further along the brook, when the character of the soil changes, boulders and the usual red drift material prevailing, none of the trees were observed. A colloquy held with a negro elicited the information that he had found one or two trees, years ago, in the woods, so they may be distributed sparingly over the adjacent territory. As might be expected from their character, these sandy fields were favorites with the Indians, and many of their implements are to be found there. Also, it may not be inappropriate to mention this locality as a new one for the yellow pine (*Pinus mitis*), a few trees growing on the neighboring hills, principally in the groves of *Pinus inops*. Of the latter trees there is one clump in particular that deserves to be recorded, on account of the size, number and beauty of the trees, which have grown close together.

Mr. Jas. Raymond presented an Indian axe, found during some excavating on the old Dongan estate at West New Brighton. Also two net sinkers from Tottenville. Mr. Davis presented a hammerstone from the locality above mentioned, near Sandy Brook, and Mr. Hollick reported finding a similar implement and some pottery at the same locality. Dr. Britton showed a skin scraper, found near the Vanderbilt Mausoleum, and two arrow heads from Mariners' Harbor. Also specimens of stilbite, from the upper Graniteville trap quarry—a mineral new to the Island.

May 9th, 1889.—A communication was read from Mr. Joseph C. Thompson, noting the capture of a twenty-one pound snapping turtle on the south side of the Island. It was two feet nine inches in length, with a carapace measuring fourteen inches in lateral and ten inches in transverse diameter.

A specimen of *Labia minor*, a species of earwig new to the Island, also captured by Mr. Thompson, was shown by Mr. Wm. T. Davis. It is found in New England, and occurs commonly in Europe.

Dr. N. L. Britton presented the celt or skin scraper, shown at the last meeting, with the following memorandum: The implement was found by Mr. Booth Davy, assistant superintendent of the Moravian Cemetery, near the Vanderbilt Mausoleum, about eighteen inches be-

neath the surface of the ground, at the foot of a large hickory tree. No other evidences of Indian occupation were noticed in the vicinity. Mr. Davy desired to present it to the Association.

Mr. E. M. Eadie showed a large lance- or spear-head from Watchogue.

Mr. Arthur Hollick presented specimens of the sandstone containing fossil vegetable remains, from the shore at Tottenville. Also similar stone from the shore at Perth Amboy. At this latter locality it was found in place, in the form of concretions, in an irregular layer at the top of the Cretaceous clay. The rock contained, besides vegetable remains, impressions of mollusca. This find is another important link in the chain of evidence identifying our Tottenville fossil leaves with the Cretaceous formation, and it is probable that the clay is almost at the surface of this locality, where it is covered by the Drift. This supposition is borne out by the fact that a new outcrop of Cretaceous clay was discovered at low tide on the beach, about a quarter of a mile west of the Prince's Bay light-house. The same sandstone occurs there, where the junction of the Drift and Cretaceous may be seen. It has not been found in the Drift under any other circumstances.

A list of Staten Island fungi, named by Mr. J. B. Ellis, from specimens in the cabinet of the Association, was presented for publication.

October 10th, 1889.—Mr. Wm. T. Davis read the following additional notes in regard to butternut trees on the Island.

In addition to the butternut trees growing along Sandy Brook, mentioned in the proceedings of April 11th, 1889, a single large tree was discovered during the past summer on a sand dune, near the Rossville Road. 'Mid the surrounding pines, wild cherries, etc., many little trees, seedlings from this one, are springing up, and if they are not destroyed by fire, there will probably soon be a considerable grove of them on this part of the Island. The dune is some distance to the west of the little swamp where Sandy Brook rises, and is nearly a mile from the trees previously reported. Mr. Wm. S. Page has informed me that trees of this species grew on the Vail place, near the bluff at Prince's Bay, and not far from Lemon Creek. A glance at the map will show, from the localities given, that the trees extend in a belt across the Island from North to South, following in a general way the direction of Sandy Brook.

Mr. George J. Hicks showed a set of five sparrow-hawk's eggs, found last May on Todt Hill, by Spire Pitou, George W. Jewett and J. J. Hicks. The nest was in a hollow tree, almost thirty feet from the ground. In the same tree were nests of the red-headed wood-

pecker and high holder. This is the first recorded instance of the nest of this bird having been found on the Island.

Mr. James Raymond presented a large stone axe, skin scraper and several arrow heads from Tottenville.

Mr. Arthur Hollick showed fossils, mostly corals, found in the yellow gravel overlying the limonite ore on Todt Hill.

Dr. Britton remarked that an outcrop of Cretaceous clay had been recently reported at the foot of Eltingville road, and Mr. Hollick stated that recent excavations near the railroad trestle beyond Arlington station had exposed Triassic shale in considerable quantity, and that the locality would probably repay careful examination. Other exposures of this formation at Mariners' Harbor and Erastina, were described in the proceedings for April 11th, 1889.

A list of the fungi in the cabinet of the Association, named by Mr. J. B. Ellis, of Newfield, N. J., was presented, which will be published as a special.

SCIENTIFIC NEWS.

THE session of the Marine Biological Laboratory during the past summer was as successful as the most sanguine could wish. Every room and table was occupied, and some applicants were refused merely on account of lack of accommodations. Altogether forty-four persons were at work there during the summer. Among the changes made the following were the more important: The northern side of the investigator's room was divided by partitions into ten small studies for advanced students, who were invited to avail themselves of the facilities of the Laboratory free of expense. Each room was furnished with table, chair, glassware, reagents, aquarium, etc. The iron water pipes were replaced by wooden ones, and a large tank was erected outside the building. The library proved extremely valuable. Through the generosity of Mrs. Evans of Boston the trustees had $1,000 to spend for books, and this was increased by an appropriation from the general fund. The result is that the library is now furnished with sets of the more important journals, while naturalists all over the United States contributed "extras" of their papers.

Twenty-five students occupied the lower laboratory, spending their time at dissecting and microscopical work, while the nineteen others present were engaged in investigation, and soon the world will begin to see the results of their work. Among the subjects studied were the

development of Actinoloba, of Edwardsia, the fertilization of echinorderms, the development of a planarian, of Spirorbis, of hydroids, of Polygordius, of Hexapods, of Limulus, of the lobster, and of Alcyonidium, the relation of the first cleavage plane to the axis of the teleosts, the head cavities of the elasmobranchs, the skull and circulation in the sharks, the formation of the germinal layers in the teleosts, the skull of the flounders, the nasal region in teleosts, Kupffer's vesicle, lateral line organs in Batrachus, the development of prosobranchs, and the morphology of the Algæ. An interesting feature was the introduction of evening lectures once a week. Such lectures were given by Drs. Whitman, Minot, Cope, Kingsley, McMurrich, Gardiner, Ayers, Wilson, and Watase.

Among the most pressing needs for the coming season are an addition to the laboratory building to afford room for lectures, library, and students, a steam launch for collecting purposes, and more books for the library.

Recent Deaths.—William Broderick, an English ornithologist, Dec. 21, 1888; Jacques Charles Puls, a Belgian entomologist, Jan. 13, 1889; Eugene Ferdinand von Homeyer, owner of one of the largest collections of European birds, at Stolp, Pomerania, May 31, 1889, aged 79 years; J. Pančie, botanist and entomologist, at Belgrade, March 8, 1888, aged 74; August Emil Holmgren, entomologist, at Stockholm, Dec. 21, 1888; Giuseppe Seguenza, geologist, at Messina, Feb. 3, 1889.

Dr. Erich Haase is a privat-docent for zoölogy in the University of Königsberg